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WATER. This important fluid was believed by the ancients to be one of the four elements out of which they imagined every other substance is composed. This opinion maintained its ground for a very long period. At length, however, it began to be suspected, from the experiments of Van Helmont, Boyle, and others. Van Helmont shewed that plants would grow for a very long time in pure water, whence it was concluded that water was capable of being changed into all the substances found in vegetables. Mr. Boyle suspected, that by long digestion and boiling in glass-veils, he had converted water partly into an earth. Margraff, who repeated his experiment, drew the same conclusion; but the opinion was never very generally admitted, and at length was proved to be erroneous, the earth being shewn to be derived from the glass-veils employed in the experiments.

The combustible nature of hydrogen gas was observed about the beginning of the 18th century, and the celebrated Scheele, many years afterwards, was the first who attempted to discover what was produced by this combustion. In this, however, he did not succeed; nor were Macquer, Bucquet, Lavoisier, Dr. Priestley, and others, who subsequently repeated the experiment with similar views, more fortunate. The distinguished honour of discovering the composition of water was referred for Mr. Cavendish, who, in 1781, proved beyond a doubt that the combustion of hydrogen and oxygen produced this fluid, and nothing else. Water, therefore, since the period just mentioned, has been universally admitted to be composed of these two gaseous principles.

Water is found in abundance in every part of the globe, and is absolutely necessary for the existence of organized beings. When quite pure, as obtained by distillation, it is perfectly transparent and colourless, and free from taste and smell.

A cubic foot of distilled water, according to the best experiments, weighs, at a temperature of 40°, 437102.4946 grains troy. Hence, a cubic inch of water at the same temperature weighs 252.952 grains; and at the temperature of 60°, 252.72 grains. The specific gravity of water is always supposed to be 1.000, and it is made the measure of the specific gravity of every other body. (See Specific Gravity, and Hydrostatics.) Water, at a temperature of 32°, becomes solid, and assumes the form of ice. In this state it possesses considerable hardness and elasitcity, and its specific gravity is diminished to .94. See Freezing, and Ice.

When water is raised to the temperature of 212° it boils, and is gradually converted into steam, which is an invisible and highly elasitic fluid like air. The specific gravity of steam, according to the most recent observations, is .625, that of air being reckoned 1.000. See Boiling, Evaporation, and Steam.

Water is capable of undergoing a slight degree of compression. See Compression.

Water undergoes no alteration by exposure to heat or light. Thus it may be made to pass through a red-hot tube without suffering any change.

On exposure to the atmosphere, it absorbs a portion of air, the greater part of which is capable of being again driven off by boiling. To expel the whole, however, it is stated to be necessary to continue the operation at least two hours in a flask, with its mouth inverted over mercury. To this small proportion of air which it holds in solution, water chiefly owes its agreeable flavour, boiled water being infipid. See Absorption, and Gas.
Hydrogen gas, even at a red heat, has no action upon water. Charcoal, when cold, does not decompose it. But when red-hot charcoal is brought in contact with water, carbonic acid and carburetted hydrogen are formed in abundance. Sulphur and phosphorus do not appear to be capable of decomposing water, even when affixed by heat; but potassium and sodium, and doubtless also the metallic bases of the alkaline earths, decompose it rapidly. Of the other metals, iron, zinc, antimony, and tin, decompose it, when affixed by heat. Silver, gold, copper, and platinum, produce no effect upon it.

Water diffuses the alkalies and alkaline earths. The acids also, and many saline compounds, are soluble in this fluid; but it is incapable of dissolving the earths properly so called.

Water combines with bodies in two different ways. It either diffuses them, in which case the proportion of water is unlimited, or it combines with them, and forms solid compounds, termed hydrates, into the composition of which the water enters in a definite proportion. The metallic hydrates, in general, are remarkable for the brilliancy of their colours. They are more soluble in acids than the oxys, and in some instances affect the organs of taste even more perceptibly than the metallic salts. This subject has been particularly investigated by M. Prout. See Hydroxide.

According to the latest and most perfect experiments, water is composed of two volumes of hydrogen gas, and one volume of oxygen gas. Hence, its combining weight or atom will be 1.125, oxygen being reckoned 1; or, if we consider the specific gravity of hydrogen gas to be 0.0944, and of oxygen gas 1.1111, it is composed of one part by weight of hydrogen, and eight parts by weight of oxygen. The union of oxygen and hydrogen gases to form water is attended by the extraction of much light and heat. See Combustion and Detonation.

Waters, Natural. — "Water," says Dr. Saunders, "is found throughout the earth in every degree of purity, except the highest, for which is never procured, except by artificial distillation, as all natural waters are constantly into contact with some substance which they can either dissolve or hold suspended." Waters to which the epithet mineral is applied, in many instances differ from other natural waters in the degree only in which they are impregnated with similar foreign substances: in other instances, they differ in the nature of the impregnating ingredient; but for the most part they differ in both these circumstances. In presenting our readers with an account of natural waters in general, we shall commence with an enumeration and short account of the different foreign ingredients usually met with in waters, and influencing their operation on the animal economy.

1. Caloric.—The temperature of natural spring-waters is the same, in general, as the mean annual temperature of the particular place in which they occur. It is evident, therefore, that this temperature must vary with the latitude. (See the articles Climate, Temperature, &c.) Waters rarely occur of a temperature much lower than the mean annual temperature of the latitude in which they are found; but inflections are met with in every part of the globe in which they occur of a higher temperature. This degree of increased temperature is very different in different instances. Commonly it is not very striking, while in other cases it is very remarkable: thus, the waters of Carlslab, in Bohemia, have the extraordinary temperature of 165°. In this country, the hottest springs are those of Bath and Buxton, the highest temperatures of which are stated to be 115° and 82° respectively. In some instances, these deviations from the natural temperature are obviously referrible to the neighbourhood of volcanoes, but generally their cause is very obscure, as we can hardly form any idea of agents operating for such a length of time, and so uniformly, as those of necessity must do which give origin to the phenomena in question: all we can infer is, that although local, they are deep-seated and permanent.

2. Atmospheric Air: Azote.—All natural waters of a mean temperature hold a portion of common air in solution. The quantity, however, has been stated by Bergman not to exceed 1/40th of the bulk of the water; and even this can only be retained at a mean temperature, and under the ordinary pressure of the atmosphere, for the greater part of it escapes when the air is submitted for a short time to a temperature of 215° or 32°. It is the oxygen contained in this small portion of atmospheric air, retained by water, that supports the respiration of fishes, and other aquatic animals, which speedily die from suffocation in water deprived of air. It is this air also, as before observed, which renders water rapid and grateful to the palate; for by boiling or distillation, this fluid is rendered insipid and disagreeable, "and has long been in disfavour," says Dr. Saunders, "for lying heavy on the stomach, and even producing cerulean mucous and obstructions." The presence of atmospheric air in water is easily accounted for, from the affinity which suffuses between the two substances, and which is such, that they soon become mutually impregnated by being exposed to each other. Azotic gas has been found to exist in small quantity in some waters, and in these instances it has been observed to be extracted from the spring itself in union with the water. As far as is at present known, this gas imparts no medicinal or even senile property to the waters containing it.

3. Carbonic Acid.—This gas is likewise flated by Bergman to exist in greater or less quantity in all natural spring-waters. The limits in which it occurs is said to lie between about 1/1000 and an equal bulk of the water. In mineral waters it is a most important ingredient, not only from its operation upon the animal economy, but from its being the solvent of various other active ingredients. When waters contain this principle in excess, they assume a bright and sparkling appearance to the eye, have an agreeable pungent acidulous taste, and sometimes exert a kind of intoxicating power when largely drunk. Fishes are unable to exist in them, and speedily die from suffocation. On exposure to the air, however, these properties in a short time become sensibly diminished, and at length almost totally disappear, owing to the separation of the gas—an operation which may still more speedily be effected by boiling. The presence of this gas in water is easily explained, from its natural affinity to that fluid. In almost every instance it is extracted from the spring in union with the water; but the source from which it is derived is, in general, obscure and inexplicable.

4. Hydrogen and its Compounds, carburetted, sulphuretted, and phosphuretted Hydrogen.—Hydrogen gas is barely soluble in water, and probably, therefore, never exists alone in that fluid. The fame is true of carburetted hydrogen. Both these gases, however, are often extracted from waters, especially when tumultuous, and containing organic substances in a state of putrefaction. Sulphuretted hydrogen is a frequent ingredient in mineral waters, and gives them a characteristic feature, that they are instantly recognized. Waters holding this gas in solution have an offensive smell, like that of rotten eggs, or a foul gun-barrel, and which is more or less strong, according to the degree in which they are impregnated. Such waters also have a taste somewhat sweetish, and they generally appear turbid. Water, at a mean
mean temperature, is finally absorbed from 3ds to 3ths of its bulk of this gas, and by long agitation more than its bulk. At a temperature of 80° or 90°, however, this fluid can with difficulty be made to dissolve any of it. Sulphuretted waters, therefore, on exposure to heat, or even to the open air without heat, soon lose their characteristic properties, and become turbid, the hydrogen being diffused, and the sulphur deposited. The source of this gas, in general, is not obscure, it being formed in great abundance during the decomposition of pyrites, and other minerals containing sulphur. Phosphuretted hydrogen is said to be occasionally extricated from marls and flagmant pools, but it is not known to constitute an ingredient in mineral waters.

5. The Alkalies and their Salts.—The fixed alkalies seldom, if ever, occur in natural waters in a free state. Even the number of their salts is so limited, that Dr. Saunders thinks it necessary to enumerate only two, namely, the sulphate and muriate of soda. The first of them is a very common ingredient in mineral waters, but rarely occurs alone in any quantity, so that it can hardly be said ever to give a peculiar character to a water. Muriate of soda is so extensively and abundantly diffused through nature, that we rarely meet with a natural water which does not contain more or less of it. Sea-water, and many natural waters or brines, owe their peculiar characters to this salt, which has been known from the earliest times, and seems to be almost a necessary ingredient in our food. The muriate of soda, however, never occurs alone in natural waters, but is commonly accompanied by some of the earthy salts, especially the sulphate of lime. Chemists have been puzzled to account for the origin of the vast quantity of this salt which is met with in the sea and elsewhere; but a little reflection will show, that the existence of this substance is not more difficult to be accounted for than that of any other ingredient of our globe. From its property of being soluble in water, it is, perhaps, more generally diffused than any other principle; but it is doubtful if it actually exists in greater abundance than silex, and many other solid substances, and which, in a geological point of view, differ from it only in the mechanical circumference of their insolubility in water. The carbonate of soda is occasionally met with in waters. Its distribution, however, is very partial, being usually in very minute quantities, or in very large ones. When in small quantity, it is generally superfused with carbonic acid. The most remarkable influence of an excess of this salt is in the “natron lakes of Upper Egypt. It is here often mixed with common salt, and they both are largely diffused in the water, and form a crust of several feet in thickness at the edge of the lake, owing to the copious evaporation of their water of solution effected by a tropical sun.” Potha, or its salts, very seldom occur in mineral waters. Carbonate of ammonia is occasionally found in small quantities in some waters, arising probably, as Dr. Saunders conjectures, from decomposed animal or vegetable substances.

6. The Earths and their Salts.—The earth most frequently occurring in natural waters is lime, and so generally is this the case, that very few instances are known in which this earth is not met with in some quantity or other. The neutral carbonate of lime, or chalk, is one of the most insoluble substances known; but the supercarbonate of lime is very soluble, and is a frequent ingredient in many springs. “It is one source of hard water in waters,” says Dr. Saunders, “but is easily got rid of by boiling, which drives off the excess of carbonic acid, and thus caustic the chalk to be precipitated; hence the earthy crust or fur on kettles in which hard water has been boiled for a number of times. Some natural waters contain an unusual quantity of this calcareous earth, which is rapidly deposited as soon as they become exposed to the air, and thereby give an earthy lining to every tube through which they flow, and encrust with the same material every substance that accident or design may put in their way. Of this kind are the various petrifying springs that form part of the natural curiosities of several mountainous districts, and have been applied to use in a very ingenious manner at the baths of St. Philip, in Tuscany, and still more extensively at Gualecavelica, in Peru.”—“The sulphate of lime (the gypsum or seifite of the older writers) is one of the commonest of all the earthy salts that are found in natural waters, and generally accompanies every saline substance, except where there is an excess of alkali. It is almost invariably found in conjunction with the carbonate of lime; and hence the calcareous depositions, petrifications, and the like, frequently contain a small admixture of seifite.” This salt imparts very little taste to water, but gives it “that rough and harsh feel to the fingers and tongue, which characterize the infipid hard waters.” The muriate of lime commonly accompanies the other salts of lime, but especially the muriate of soda. When in excess in any water, it imparts to it a bitter and disagreeable taste, and active medicinal properties. The great bitterness of “the waters of the Dead sea is owing to the muriates of lime and magnesia, and not to bitumen, as was erroneously supposed.” The carbonate of magnesia is insoluble in water; the supercarbonate of magnesia, when it occurs in waters, is always accompanied by the supercarbonate of lime, both the elements being held in solution by an excess of carbonic acid. The supercarbonate of magnesia, however, is more soluble than the supercarbonate of lime, and is not, therefore, so easily separated by boiling. The sulphate of magnesia, or Ephesin salt, as it was formerly denominated, is the most important of the salts of this earth. It almost always accompanies the sulphate of soda; and to these two salts most of the natural purging waters owe their cathartic properties. It is likewise frequently combined with the sulphate of lime, and also with iron. The sulphate of magnesia imparts to the waters containing it a very considerable quantity a strongly bitter and saline taste. It was first discovered in a spring at Ephesus, whose name; but is usually prepared at present from the refuse salt of sea-water, after the common salt has been separated. The muriate of magnesia, as before-mentioned, commonly accompanies the muriates of soda and lime; hence it is found in various brine-springs, and forms a considerable part of the saline contents of sea-water, to which fluids, especially when concentrated by evaporation, it imparts a strong bitter taste. Salts of alumina are not of very frequent occurrence in waters. The most common is the superphosphate of alumina, or common alum, which is usually associated with the sulphate of iron. The source of this salt is for the most part alum-flake, the sulphur contained in which becomes acidified on exposure to the air, and forms sulphuric acid, which, uniting with the alumina, produces the salt in question. The presence of the sulphate of iron is easily accounted for upon similar principles, since more or less of iron pyrites almost invariably accompanies alum-flake. Silex, in a state of minute division, is sometimes found suspended in small quantity in running waters, but is soon deposited on their remaining at rest. This earth, however, occasionally occurs in a state of solution in hot and tepid springs, especially in the neighbourhood of volcanoes. The meniscus appears to be usually a little free or carbonated alkali, the solvent powers
Metals and their Salts.—The metal most usually met with in natural waters is iron; never, however, in its metallic state, but in a state of oxidized combined with an acid. The carbonate of iron is a frequent ingredient of natural waters, the base of which is the black or protoxyd of the metal, for the red oxys of iron do not seem capable of combining with carboxylic acid, or at least of forming with it a soluble compound. This is, doubtless, a wise provision of nature; for, as Dr. Saunders justly observes, if the contrary were the case, almost every natural water would be a chalybeate. The carbonate of iron, like all the other salts of this metal, imparts to waters containing it a peculiar inky tinge, “which,” says Dr. Saunders, “is very perceptible, even when the proportion of iron is so small as hardly to be determinable by any chemical process.” Waters containing this salt in any quantity, possess the properties of chalybeates in a high degree, and are peculiarly healthful. The muriate of iron is occasionally met with in natural waters; but its existence in any considerable quantity is a rare occurrence. Copper, or rather its salts, and especially the sulphate of copper, is occasionally met with in natural waters. This generally, however, occurs in the neighbourhood of copper-mines; and the sulphate of copper, as Dr. Saunders observes, is probably formed, like the sulphate of iron, by the decomposition of copper pyrites. Waters containing this metal are highly poisonous, and are never used internally. Manganese is occasionally found in small quantity in natural waters. It appears, in general, to be associated with iron; but the state in which it exists is not accurately known. As far as present observation goes, it imparts no sensible or other properties to the waters containing it. Lead, perhaps, never naturally occurs in waters; but some waters have the property of dissolving, or holding in suspension, a minute portion of this pernicious metal, when exposed to it in the metallic state. Pure soft waters are said to possess this property in the most striking degree.

Mineral Acids.—Both the muriatic and sulphuric acids are occasionally met with in mineral waters in a free state. Such springs usually occur in volcanic countries.

Bitumen.—Bitumen is said by many of the older writers to be a frequent ingredient in mineral waters. This statement, however, has been generally found erroneous by modern chemists, who have in most cases demonstrated the supposed bituminous principles of their predecessors to be substances of a very different nature. There are some springs, however, which yield a real bitumen; but this, from its insolubility in water, is never dissolved in that fluid, except in a few rare instances, through the medium of an alkali.

Such is a short account of the principal mineral substances which are met with in natural waters when they issue from the earth. "When," says Dr. Saunders, "they flow within a channel over the surface of the ground, they often become much changed in their chemical composition, losing some of their contents by evaporation, others by deposition, or by being decomposed through the influence of light and air. At the same time they often acquire new contents, which are furnished by the soil over which they flow. Thus the streams which pass over a country covered with vegetable matter, or which water large towns, will contain a sensible quantity of mixed alluvial contents, or a heterogeneous compound of animal and vegetable extract of mucilage.

Different authors have chosen different principles of arrangement in treating of natural waters. An arrangement purely chemical, or purely medicinal, cannot be effectual in the present state of our knowledge; we shall not therefore attempt either, but shall consider them under the following heads:

1. Potable waters.
2. Saline waters.
3. Chalybeate waters, simple and compound.
4. Acidulous waters, simple and compound.
5. Sulphureous waters, simple and compound.
6. Thermal waters, simple and compound.

This arrangement of natural waters, according to their sensible properties, coincides likewise, as well perhaps as the present state of the subject will admit, with their chemical and medicinal properties. It may, however, be objected to the divisions simple and compound, that neither of them is accurately correct, and this must be admitted in a strictly chemical point of view; but taken in the enlarged and general sense here understood, there seems to be no serious objection to this mode of division.

1. Potable Waters.—Under this division we wish to include every variety of this fluid ordinarily used by mankind and other animals for satisfying their thirst. They may be comprehended under the heads of, a, pure or distilled water; b, atmospheric water; c, spring-water; d, running water, and e, flagrant water.

a. The chemical properties of pure water have been already described at the head of this article. As before observed, it never occurs in nature, and was therefore probably never intended as an article of drink for mankind; certainly, at least, not as one absolutely necessary for their existence, or even healthy condition.

b. Under atmospheric waters are included rain-water, snow-water, dew, &c.

Rain-water, collected at a distance from large towns, or any other object capable of impregnating the atmosphere withnoxious materials, approaches more nearly to a state of purity than perhaps any other natural water. Even collected under these circumstances, however, it invariably yields traces of the muriatic acid, and, according to Margraaff, of the nitric also. Rain-water of course differs according to the state of the atmosphere through which it passes. "The heterogeneous atmosphere of a smoky town," says Dr. Saunders, "will communicate some impregnation to rain as it passes through; and this, though it may not be at once perceptible on chemical examination, will yet render it liable to spontaneous change; and hence rain-water, if long kept, especially in hot climates, acquires a strong inell, becomes full of animalcula, and in some degree putrid." Rain-water in general, in warm climates, is much more impure and liable to become offensive than in cold and temperate ones. Rain also that falls in the spring and summer, or after a long-continued drought, or very hot weather, is said to be more impure than that which falls at other seasons of the year, or after a long-continued moist season; circumstances, doubtless, owing to the existence of a greater proportion of animal and vegetable principles in the atmosphere in such climates and seasons. These foreign substances have sometimes been so abundant and peculiar in their appearance, as
to have given origin to many marvellous stories, such as the
raining of blood, &c. (See the article RAIN.) The spe-
cific gravity of rain-water hardly differs from that of dif-
tilled water; and from the minute portions of the foreign
ingredients which it generally contains, it is very soft, and
admirably adapted for many culinary purposes, and various
procees in different manufactures and the arts.

Snow-water equals, if not surpasses, rain-water in purity,
when collected under the same circumstances, it being
for obvious reasons more free from animal and vegetable
impregnations; thus Dr. Rutty found it perfectly sweet
after keeping it in a clove vell for eighteen months. Snow-
water, like rain-water, even in its purest state, yields traces
of muriatic acid, and perhaps also of the nitric.

Hall-water may be compared to snow-water, which it
closely resembles: indeed

Ice-water in general is very pure, as the air and saline sub-
fstances are separated by freezing. Common ice-water, how-
ever, is less pure than rain and snow water, as the foreign
substances, though perhaps separated by freezing, still re-
main incorporated with the ice, so that it is impossible to
melt the ice without retaining at least a portion of these for-
"eign matters.

Dew, being deposited chiefly from the lower parts of the
atmosphere, is commonly much more impure than rain or
snow water. According to Dr. Rutty's observations, it
soon becomes acid and offensive. It yields also more sen-
itive traces of the presence of muriatic acid than rain-water.

This fluid, however, collected at different places and
times, differs exceedingly in its properties, as might be na-
turally expected.

c. Spring-water includes well-water, and all others that
arise from some depth below the surface of the earth, and
which are used at the fountain-head, or at least before they
have run any considerable distance exposed to the air.

Although all spring-waters are originally of atmospheric origin,
yet they differ from one another according to the nature of
the soil or rock from which they issue; for though the in-
gredients usually existing in them are in such minute quan-
tities as to impart to them no striking medicinal or febile
properties, and do not render them unfit for common pur-
poses, yet they modify their nature very considerably. Hence
the water of some springs is said to be hard, others soft, some
sweet, others brackish, &c. according to the degree and nature
of the impregnating ingredients. Common springs perish-
fibly into mineral or medicinal springs, as their foreign con-
ents become larger or more unusual; or in some instances
they derive medicinal celebrity from the absence of those ingre-
dients usually occurring in spring-water; as, for example,
is the case with the Malvern and other springs. Almost all
spring-waters possess the property termed hardness in a greater
or less degree. This hardness, as we formerly mentioned,
depends chiefly upon the sulphate and carbonate of lime
which they hold in solution. The quantity of these earthy
salts varies very considerably in different milancs; but Dr.
Saunders observes, that when they exist in the proportion of
five grains in the pint, such water will be hard, and from
its property of decomposing soap will be unfit for washing.
and many other purposes of househoeld use or manufacturces.

The water of deep wells, according to Dr. S., is always
ceteris paribus, much harder than that of springs which over-
flow their channel; but there are many exceptions to this rule.

The fofn's of spring-waters depends on their containing
smaller proportions of the earthy salts above-mentioned.

Spring-waters are said to be brackish, when they contain a
small proportion of the muriates of foda, magnesia, or lime,
as is frequently the case in the neighbourhood of the sea.

Sweetness is generally understood as opposed to brackishness or
salt when applied to spring-waters. The specific gravity of
spring-waters in general is greater than that of distilled
or any other potable water. See Spring.

d. Running waters include river-waters, and every other
species of water exposed to the air, and moving in an open
channel. On this part of our subject we cannot do better
than quote from Dr. Saunders. "River-water," says Dr.
S., "in general is much softer, and more free from earthly
faits than spring-waters, but contains less air of any kind;
for by the agitation of a long current, and, in most cases, a
great increafe of temperature, it loses common air and car-
bonic acid, and with this lost much of the lime which it
held in solution. The specific gravity thereby becomes less,
the taste no longer, but is fresh and agreeable, and out
of a hard spring is often made a stream of sufficient puri-
ity for most of the purposes where a soft water is required.

Some springs, however, that arise from a clean flaggy
rock, and flow in a sandy or stony bed, are from the outlet
remarkably pure, such as the mountain lakes and rivulets
in the rocky districts of Wales, the source of the beautiful
waters of the Dee, and numberless other rivers that flow
through the hollow of every valley. Switzerland has long
been celebrated for the purity and excellence of its waters,
which pour in copious streams from the mountains, and give
rise to some of the finest rivers in Europe."—"Some rivers,
however, that do not take their rise from a rocksy foil, and
are indeed at first considerably charged with foreign mat-
ter, during a long course, even over a richly cultivated plain,
become remarkably pure as to saline contents, but often
fouled with mud and vegetable or animal exuviae, which are
rather fulfilled than held in true solution. Such is that of
the Thames, which, taken up at London at low water, is
very soft and good water, and after rest and filtration it
holds but a very small portion of any thing that could prove
noxious, or impede any manufacture. It is also excellently
fitted for sea-flour, but it here undergoes a remarkable spo-
taneous change. No water carried to sea becomes putrid
sooner than that of the Thames. When a cask is opened,
after being kept a month or two, a quantity of inflammable
air (carburetted or sulphuretted hydrogen) escapes, and the
water is so black and offensive as scarcely to be borne.

Upon racking it off, however, into large earthen vessels,
and exposing it to the air, it gradually deposits a quantity of
black sliny mud, becomes clear as crystal, and remarkably
sweet and palatable. The Seine has a high reputation in
France, and appears, from the experiments of M. Parmentier,
to be a river of great purity. It might be expected that a
river which has passed by a large town, and received all its
impurities, and been used by numerous dyers, tanners, hat-
ters, and the like, that crowd to its banks for the conver-
ience of plenty of water, should acquire thereby such a
foulness as to be very perceptible to chemical examination
for a considerable distance below the town; but it appears
from the most accurate examination, that where the stream
is at all considerable, these kinds of impurity have but little
influence in permanently altering the quality of the water,
expecially as they are for the most part only suspended,
and not truly dissolved; and therefore mere refit, and exes-
cially filtration, will restore the water to its original purity.

Probably therefore, the most accurate chemist would find it
difficult to distinguish water taken up at London from that
procured at Hampton-court, after each had been purified by
simple filtration." The water of the Ebro also, notwithstanding
this river passes through several large towns, is re-
markable for its purity. In general, those rivers which fli
from lakes are most pure and transparent, while those chiefly
supplied
supplied by springs and rain are the reverse. The water of some rivers is remarkable for its colour: thus that of the Tinto, in Spain, at its source is of a fine topaz, a circumstance from which the river takes its name. Others are of a yellowish or greyish-white, and the water of all such rivers usually holds a large proportion of some faint of lime in solution. In countries where boggs and marshes abound, the rivers are often tinged of a brownish colour.

e. Stagnant Waters.—Under this head are included the waters of lakes, pools, and reervoirs of every description, in which this fluid is exposed to the air in a state of rest. Stagnant waters, in general, present greater impurities to the senses than any others, from their usually containing a large proportion of animal and vegetable matters in a state of decomposition. Their taste in general is rapid, and delitable of that fetid and agreeable cools which distinguishes spring-water. Stagnant waters have various origins, but usually they are a mixture of rain, spring, and river water; and hence, besides the animal and vegetable matters they contain, may be supposed to be impregnated with the various saline matters usually met with in such waters. Many stagnant waters are said to contain the nitrates of potash, and, especially some lakes, abound in the sulphate of magnesia; others in the carbonate of soda, as, for example, the patron lakes of Egypt and Hungary, which are generally very shallow. A lake in Thibet is impregnated with the borate of soda mixed with the muriate of soda, the waters of which seem to have a subterranean origin. Some lakes also are found impregnated with sulphuretted hydrogen gas. Stagnant waters are seldom perfectly colourless and transparent. Lakes, when deep, are usually of a blueish tinge, mixed with green; and when the neighbouring hills are covered with peat, &c., their water is always of a muddy-brownish tinge, as, for example, is the lake of most of the lakes in Scotland.

1. Uses of Potable Waters.—If we were to be directed by the evidences of the senses alone, spring-waters would undoubtedly be pronounced to be the most wholesome, for they are universally admitted to be the most agreeable. All other waters have more or less of a flat insipid taste. This is especially the case with distilled and rain water; the first of which is quite pure, and the second nearly so. Distilled water, therefore, is seldom employed for drinking; and the difficulty of procuring it in large quantities almost precludes its use to any extent in the preparation of food, or in manufactures. Much, however, has been lately said of its medicinal powers by Dr. Lambe, who has recommended it in cancerous and other affections; and, as Dr. Saunders justly observes, water, when not already loaded with foreign matters, may become a solvent for concretions in the urinary passages; and as much good has been obtained from the use of very pure natural springs, a course of distilled water may be considered as a fair subject of experiment. Distilled water is an essential ingredient in the composition of many medicines, and often absolutely necessary in the prosecution of all nicer chemical processes in the liquid way. Snow and ice water form almost the coldest drink of the inhabitants of cold climates during winter; and the maffles of ice which float on the polar seas afford an abundant supply of fresh water to the mariner. “Snow-water,” says Dr. Saunders, “has long lain under the imputation of occasioning those infamous swellings in the neck which deform the inhabitants of many of the Alpine valleys; but this opinion is not supported by any well-authenticated indisputable facts, and is rendered still more improbable, if not entirely overturned, by the frequency of the disasters in Sumatra, where ice and snow are never seen, and its being quite unknown in Chili and Thibet, though the rivers of those countries are chiefly supplied by the melting of the snow with which the mountains are always covered.” Dew, especially when collected in the month of May, was formerly in great repute as a cosmetic, and for many other purposes; but its use has been long entirely laid aside. Spring-waters, as before observed, from the air they contain, and from their grateful coolness, constitute by far the most agreeable of the potable waters, and are in more general use than any others. Their use, however, is flattered sometimes to occasion in delicate florins an uneasy sense of weight, followed by a degree of dyspepsia. They have also been accused, especially when of the description termed hard, of inducing calculous affections; but this notion by most modern writers is considered as ill-founded. Spring-waters, in general, also, from their property of hardening, are, as before observed, very ill adapted for many domestic and other purposes; while, in particular instances, this quality is of advantage. Hard spring-waters, for example, are very ill adapted for the purposes of the dyer or bleacher. “On the other hand,” says Dr. Saunders, “there are several saline sublimates which are very readily soluble in any kind of water, and here a hard water may be employed when the object is only to procure these particular salts. For culinary purposes, water is used either to soften the texture of animal or vegetable matter, or to extract from it, and present in a liquid form some of its soluble parts. Soft pure water will fulfill both these objects better than hard water; and at the same time the colour of the sublimates employed will vary as well as its solutton. Green vegetables and pulse are rendered quite pale, as well as tender, by boiling in soft water; whereas in a hard water, the colour is more preferred, and the texture less altered, because in the former the colouring matter of the vegetable is readily extracted from the meridian, whilst in the latter more of it remains, and is likewise altered by the chemical action of the earthy or neutral salts.” Dr. S. then relates some comparative experiments made with hard and pure water upon tea; from which he concludes that hard water is less powerful in softening the texture of vegetable leaves than soft water, and that it is not able to exert its full effect in heightening their colour till as it is by heat; and also, that the gallic acid (or tannin) is equally well extracted by hard as by soft water, when by raising the temperature, the power of the former as a solvent is fully exercised. It may be therefore laid down as a general rule in domestic economy, that when the object is to extract the virtue of a substance, and to retain them in solution, soft waters should be used; but that when the object is the reverse, or to prefer the one as possible the article used as food, hard waters are preferable.

Some fine springs of very pure and soft water have been long celebrated for their medicinal properties; as, for example, the Malvern springs, in Worcestershire, and St. Winifred’s Well, at Holywell, in Flintshire. Malvern water is used both externally and internally. Externally applied, it is fluted to be a most useful application to deep-seated ulcerations of a feborous nature, and to various cutaneous affections. Its internal use is often of advantage in painful affections of the kidneys and bladder, attended with the distintegration of bloody, purulent, or febrile urine; the hectic fever produced by seborous ulcerations of the lungs, or very extensive and irritating ones on the surface of the body; and also fistulae of long standing, that have been neglected, and have become confluent and troublesome ones.” The internal use of this water sometimes induces nausea at first, and occasionally drowsiness, vertigo, and head-ache, which soon go off, or may be readily removed by a mild purgative.
purgative. This water occasionally purges, but most commonly the body becomes costive under its use. "In all cases, it increases the flow of urine, and improves the general health of the patient; so that his appetite and spirits almost invariably improve during a course of the water, if it agrees in the first instance." The duration of a course of this water depends in a great degree upon the nature of the disease under which the patient labours. These observations upon the effects of the Malvern water are perhaps equally applicable to all spring-waters of a similar degree of purity.

What has been said of spring-waters may be applied perhaps with little modification to running waters, which in general differ from spring-waters only in being softer, in containing less air, and in being therefore better qualified for many purposes for which spring-waters cannot be employed. stagnant waters in general, especially in marshy countries and hot climates, are usually esteemed unwholesome, and perhaps deferred to. This arises chiefly from the large quantity of vegetable and animal exuviae which they contain, and perhaps from other circumstances of which we are at present ignorant. They should never be used, therefore, till they have been boiled and filtered; by which process most of the foreign substances will be probably removed. In general stagnant waters, as Dr. Saunders observes, are unpalatable; and this circumstance has probably caused them to be sometimes in worse credit than they actually deserve to be on the score of falsity.

2. Simple saline Waters. — Under this denomination we include all those waters impregnated with neutral, alkaline, and earthy salts only. Waters of this description may be arranged under the following heads: —

a. Brines, or waters whose principal saline ingredients are the muriates of soda and magnesia; and b. Bitterns, or waters containing principally the sulphates of soda and magnesia.

a. Sea-water, which may be considered as an example of the saline waters termed brines, is one of the most abundant and extensively diffused compounds occurring upon our globe. When taken up at a considerable distance from the shore it is quite transparent and colourless, and free from any smell. Its taste is strongly saline, and at the same time nauseous and bitter. When kept for a short time it becomes highly offensive, from the putrefaction of the animal and vegetable matters which it holds in solution. Its specific gravity varies in different latitudes and circumstances, but may be found to lie between 1.0269 and 1.0285. The specific gravity is said to be less within the polar circles than at the tropics, owing probably to the vast quantities of ice found in those regions. The waters of inland seas also, that have little connection with the ocean, and the water of bays, &c. into which fresh-water rivers empty themselves, contain in general less saline matters than the open ocean. This is particularly the case with the Baltic, especially when the wind blows from the east. The Mediterranean sea, on the contrary, is said to be more saline than the Atlantic. Water taken from a considerableness depth is more saline than that taken from the surface, particularly after much rain, for rain-water being lighter appears to move upon the surface for a considerable time before it becomes quite incorporated. The quantity of saline matter also is said to be greater in summer than in winter. The water of the British coasts is said to contain upon an average about one-thirtieth of its weight of saline matter, and its temperature to vary between 40° and 65°. Sea-water does not freeze till cooled down to 28.75°. The following is one of the latest analyses of sea-water by Dr. Murray. A

<table>
<thead>
<tr>
<th>Wine Pint of Water Collected in the Firth of Forth</th>
<th>Grams</th>
</tr>
</thead>
<tbody>
<tr>
<td>Of lime</td>
<td>2.9</td>
</tr>
<tr>
<td>Magnesia</td>
<td>14.8</td>
</tr>
<tr>
<td>Soda</td>
<td>96.3</td>
</tr>
<tr>
<td>Sulphuric acid</td>
<td>14.4</td>
</tr>
<tr>
<td>Muriatic acid</td>
<td>97.7</td>
</tr>
</tbody>
</table>

Or, supposing the elements to be combined in the modes in which they are obtained by evaporation; that is, as muriate of soda, muriate of magnesia, sulphate of magnesia, and sulphate of lime, the proportions of these salts in a pint will be,

<table>
<thead>
<tr>
<th>Muriate of soda</th>
<th>grams</th>
</tr>
</thead>
<tbody>
<tr>
<td>Of magnesia</td>
<td>23.0</td>
</tr>
<tr>
<td>Of lime</td>
<td>15.5</td>
</tr>
</tbody>
</table>

Or, supposing that the lime exists as muriate of lime, (which is the most probable conclusion with regard to it), and farther, supposing that the sulphuric acid exists in the state of sulphate of magnesia, the proportions will be,

<table>
<thead>
<tr>
<th>Muriate of soda</th>
<th>grams</th>
</tr>
</thead>
<tbody>
<tr>
<td>Of magnesia</td>
<td>18.3</td>
</tr>
<tr>
<td>Of lime</td>
<td>7.7</td>
</tr>
</tbody>
</table>

Or, lastly, supposing that the sulphuric acid exists in the state of sulphate of soda, the proportions will be,

<table>
<thead>
<tr>
<th>Muriate of soda</th>
<th>grams</th>
</tr>
</thead>
<tbody>
<tr>
<td>Of magnesia</td>
<td>35.5</td>
</tr>
<tr>
<td>Of lime</td>
<td>5.7</td>
</tr>
</tbody>
</table>

The bitter taste of sea-water is owing chiefly to the muriate of magnesia which it contains. It may also arise, in part, from the presence of decayed vegetable and animal substances. See the articles SALT, SALTINESS, and SEA. Many attempts have been made to render sea-water potable. Of these the belt, and indeed the only good one, is distillation.

The method of obtaining fresh water from the distillation of sea-water was practised by Sir R. Hawkins, in the reign of queen Elizabeth, who thus obtained water that was wholesome and nonirritating. See Purchas's Collect. of Voyages, book vii. chap. 5.

Experiments were afterwards made by Hales, Lister, Hanton, Lind, and others, to simplify and render more perfect the process of distillation, and at length it attained a great degree of perfection, both in France and England. Thus M. de Bougainville, in his Voyage round the World, bore ample testimony to the utility of the machine for distilling sea-water, which had been made public in 1763 by M. Poissonnier, its inventor; and lord Mulgrave, in his Voyage
WATER.

Voyage towards the North Pole, in 1773, did equal justice to the method of obtaining fresh water from the sea by distillation, which had been introduced into the English navy in 1770, by Dr. Irving, and for which he obtained a parliamentary reward of 5000l.

Dr. Irving’s contrivance consisted in converting the ship’s kettle into a still. Every ship’s kettle is divided into two parts, by a partition in the middle; one of these parts is only in use when peas or oatmeal are drest, but water is at the same time kept in the other, to preserve its bottom. Dr. Irving availed himself of this circumstance; and by filling the spare part of the copper with sea-water, and fitting on the lid and tube, shewed that sixty gallons of fresh water could be drawn off, during the boiling of either of the above-mentioned provisions, without the use of any additional fuel. He recommended also the preserving of the water distilled from the coppers in which peas, oatmeal, or pudding, are drest, as both a salutary beverage for the scorbutic, and the most proper kind of water for the boiling of salt provisions. Dr. Irving particularly directed that only three-fourths of the sea-water should be distilled, as the water distilled from the remaining concentrated brine was found to have a disagreeable taste; and as the farther continuation of the distillation proved injurious to the vessels. For an account of the several experiments made on some of the best distilled water, prepared by Dr. Irving from sea-water, by Dr. Watfon, see his Chem. Eff. vol. ii. p. 168, &c.

The ships of discovery lately sent out by the French government are furnished with an economical distilling apparatus, and instead of water have taken with them a supply of fuel.

Dr. Priestley suggested a plan to give to distilled water the briskness and spirit of fresh spring-water, and at the same time to render it, perhaps, a remedy or preventive against the feevry, by impregnating it with carbonic acid gas. Distilled water also acquires, in a considerable degree, the grateful flavour of common water, by timple exposure for some time to the atmosphere.

Sea-water may be likewise rendered potable by converting it into ice. In the polar regions, therefore, there can be no want of fresh water. In warm climates, the ingenious freezing apparatus of Mr. Leflie may be employed to procure a supply of fresh water from the ocean.

b. As an example of the bitterns we may select the Sedlitz water, which is one of the best known, and strongest of this description of simple saline waters. Sedlitz is a village in Bohemia, and its waters, as well as those of Seydorfschutz in the immediate neighbourhood, and which closely resemble them, were first brought into notice about a century ago by the celebrated Bergman. The taste of these waters is strongly bitter and saline, but not in the least brisk or acidulous, as they usually contain a small proportion of gaseous matters. Thus the Seydorfschutz water above-mentioned was found by Bergman to yield only 6 per cent. of gaseous products, two-thirds of which only were carbonic acid. Its specific gravity, as stated by the same chemist, is 1.006, and an English wine pint was found to contain of

<table>
<thead>
<tr>
<th>Substance</th>
<th>Grains</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbonate of lime</td>
<td>-500</td>
</tr>
<tr>
<td>Sulphate of lime</td>
<td>-140</td>
</tr>
<tr>
<td>Carbonate of magnesia</td>
<td>-222</td>
</tr>
<tr>
<td>Muriate of magnesia</td>
<td>-457</td>
</tr>
<tr>
<td>Sulphate of magnesia</td>
<td>-497</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>193.770</strong></td>
</tr>
</tbody>
</table>

Sulphate of soda is not mentioned as an ingredient in this water, although it doubtles exisits in it; at least this fact almost always occurs in waters of this description.

Medicinal Properties and Uses of the simple saline Waters.—All waters of this description act more or less strongly upon the bowels, according to the quantity of saline ingredients which they contain; hence they are often of the greatest use in complaints where alvine evacuations are particularly indicated. They generally act also as diuretics. Sea-water and all brines have the property of inducing a fermentation of thirst. "Sea-water," says Dr. Saunders, "when used internally, should be taken in such doses as to prove moderately purgative, the increase of this evacuation being the peculiar object for which it is employed: about a pint is generally sufficient, and this should be taken in the morning, at two doses, with an interval of about half an hour between. It is seldom necessary to repeat the dose at any other time of the day. This quantity contains half an ounce of purgative salt, of which about three-fourths are nitrate of soda."—"There is very little danger ever to be apprehended from an excessive dose of sea-water, except the inconvenience of a temporary diarrhoea, and sometimes a forenses at the extremity of the rectum, which all saline purgatives are now and then apt to produce." The internal use of sea-water, besides its general use in diseases where cathartics are indicated, has been recommended in various forms of scrofulous affection, especially in indolent glandular tumours in the neck and other parts, which are commonly slow in ulcerating and in their cure; also in deep-seated scrofulous inflammations, followed by caries of the bones, profuse discharges, and tedious exfoliation, and particularly in scrofulous ophthalmia. "In such cases, the internal use of sea-water is almost entirely confined to those periods of the disease when there is no general fever and hectic tendency, when no symptoms of danger are present, and when the object is rather to prevent a relapse than oppose any present disease. The external use of sea-water either as a general cold bath, or as a topical application to indolent swellings, or granulating ulcers, when the healing process has commenced, coincides perfectly well in these cases with the general intention." The most important advantages of sea-water are indeed probably derived from its external use as a bath. (See the articles BATH and BATHING.) With respect to the medicinal properties of the bitterns, we shall attempt to illustrate them by relating those of the Sedlitz water, which we before selected as an example of the whole tribe. A pint of this water, taken in divided portions, is generally a full dose for an adult, and the strongfet person seldom requires more than two pints. It operates very speedily, and without producing griping or flatulency; and is stated by Hoffmann, as quoted by Dr. Saunders, to be of the utmost advantage in a foul state of the stomac, and general torpor of the intestinal canal, as it not only stimulates these organs to expel their morbid contents, but by its bitter性质 refolores their tone, and with it the appetite and digestive powers. "When the presence of hypochondriasis is marked by anxiety, general languor, perturbed dreams, a vivid hue on the face, difficulty of breathing, pain of the back and head, vertigo and coldness of the extremities; when a bilious humour and a depraved secretion of the stomac impairs its tone and healthy action, and is attended with obstinate coltiveness; this water, by evacuating its contents and restoring the due force of contraction, enables it to throw off the offending matter."—"Numerous trials also have shewn the efficacy of this saline water in that cachexy of females attended with a suppression of the menstrual discharge, whereby...
WATER.

whery are produced a general languor, difficult respiration, febrile heat and irritation, waking of the body, and lofs of appetite. Also when women have arrived at that time of life when this periodical evacuation begins to cease, and is succeeded by a number of anomalous disorders, such as prostration of appetite, flatulent pains, irregular flushings, pains in the back and swelling of the feet, a course of Selditz water restores the waving appetite, and difpofes the tumours and other morbid symptoms. Men of from forty to fifty years of age, who have led a very sedentary life, and have been accustomed to intense thought and profound meditation, become frequently affected with edematous tumours in the extremities, a want of due action in the fiamach, eruptions after taking food, and a generally impaired state of health; all of which are for the most part very certainly removed by a liberal use of this water. Perhaps also of a plethoric habit of body, who from some obstruction of blood in the abdominal viscera, and have acquired a strong disposition to hemorrhoidal affections, become thereby often exposed to very serious evils. To such person a faltine water like that of Selditz is oftent of great utility, especially if accompanied by blood-letting when requisite, and a general anti-phlogiftic plan of cure. Another important use of faltine waters is in removing from the fystem those impurities and acid humour which are ufually termed fcorbutic." Such are the properties of the Selditz faltine waters according to the celebrated Hoffmann, whose account, as quoted by Dr. Saunders, we have extracted, because it presents in fhort words a comprehensive and rational view of the medicinal properties of this important tribe of waters in general. We will however to observe, that when the fiamach is in a very weak flate, and dyspepsia is present in a very great degree, faltine purgatives and waters in general may do harm by increasing these affections; their use, therefore, in fuch fakes is rather contra-indicated, or at leafl should be combined with other remedies calculated to invigorate these organs, efpecially chalybeates.

3. Simple chalybeate Waters.—Chalybeate waters are either simple or compound. Under this head of simple chalybeates we include all waters whose characteriftic ingredient is one or more of the neutral falks of iron. These may be confidered as of two general defcriptions:—a. Waters containing the carbonate of iron, without any xrking excess of carbonic acid; and b. Waters containing the sulphate or muriate of iron, generally in combination with a large proportion of the sulphate of alumina. Waters of this laft description are much more rare than the former, and are usually formed from the decomposition of iron pyrites.

a. As an example of the firft of these varieties of simple chalybeate waters, we may adduce that of Tunbridge Wells. This water has been lately submitted to a careful and accurate analysis by Dr. Scudamore, from whose pamphlet on the subject we briefly take the following account. The temperature of the spring throughout the year is uniformly 50°; and its fp. gr. in the month of August, at its natural temperature, was 1.007. The frefh water is perfectly transparent, and does not fend forth air-bubbles. It exhales a smell which is distinctly chalybeate. Its taste in this refpeft is strongly marked, but is neither acidulous nor faltine. It has an agreeable freffnefs, and is by no means unpalatable. Submitted to analysis, one gallon was found to contain:

<table>
<thead>
<tr>
<th>Of carbonic acid</th>
<th>Grains.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Of oxygen</td>
<td>0.50</td>
</tr>
<tr>
<td>Azote</td>
<td>4.75</td>
</tr>
</tbody>
</table>

Vol. XXXVIII.

Of muriate of soda - - - 2.47
Of lime - - - 1.25
Of magnesia - - - 1.47
 Sulphate of lime - - - 1.41
 Carbonate of lime - - - 2.7
 Oxyd of iron - - - 2.29
 Traces of manganfe, infoluble matter (vegetable fibre, flilex, &c.) 44
 Lofs in procelfes - - - 1.13

7.69

Or, floating the results according to Dr. Murray's view, which will be particularly explained when we treat of the analysis of mineral waters, the following estimate will appear:

| Muriate of soda - - - 1.25 |
| Sulphate of soda - - - 1.29 |
| Muriate of lime - - - 1.54 |
| Of magnesia - - - 0.29 |
| Carbonate of lime - - - 2.7 |
| Oxyd of iron - - - 2.29 |
| Traces of manganfe, &c. - - 44 |
| Lofs, &c. - - - 1.13 |

7.68

This latter estimate, which renders the carbonate of iron the most abundant ingredient in the water, appears much more probable than the former, and to account more satisfactorily for its medicinal effects.

b. One of the most striking examples of the second variety of simple chalybeate waters is that occurring in the Isle of Wight, and lately analysed by Dr. Marrot. This spring issues from a cliff on the S.S.W. side of the ifle, immediately under St. Catherine's Down, in the parifh of Chale, between which village and the village of Niton it is nearly equidistant. The distance from the sea-shore is about 150 yards, and elevation about 130 feet above the level of the sea. Its properties, &c. are the following:—When it ft first issues from the rock it is perfectly transparent, and remains fo if kept in clofe vesfils; but when exposed to the air, reddish flakes are foon deposited in it. It has a flight chalybeate fmal, and a highly astringent and ftyptic taste. Its specific gravity, in a course of feveral experiments, was found to be 1007-5. One pint or fixteen-ounce measures yielded

Of carbonic acid 4ths of a cubic inch, - - - 1.29
Of sulphate of iron, in the flate of cryflalized green sulphate - - - 41.4
 Of sulphate of alumina, a quantity of which, if brought to the flate of cryflalized alum, would amount to - - - 31.6
 Of sulphate of lime dried at 160° - - - 10.1
 Of sulphate of magnesia cryflalized - - - 3.6
 Of sulphate of foda cryflalized - - - 16.0
 Of muriate of foda cryflalized - - - 4.0
 Of silica - - - 0.7

107.4

This therefore is the strongeft alumifh chalybeate known.

Medicinal Properties and Uses of simple chalybeate Waters.—a. The feafon for drinking the Tunbridge water, which we have selected as an example of the fimple carbonated cha-

ybeates,
lybeates, is usually from May to November. On entering upon the use of this water some aperient should be premised; and Dr. Scudamore recommends that the first dose should be taken at seven or eight o'clock in the morning, the second at noon, and the third about three in the afternoon. The exact quantity to be taken must be varied according to circumstances; but "as a general statement," says Dr. S., "I would say that half a pint daily is the extreme smallest quantity, and that two pints daily is the extreme largest amount to find a just expectation of benefit; and further, in the way of general outline of direction, I conceive that half a pint, a pint, a pint and a half, and two pints, should form the progressive ratio of the total daily quantity to be taken at the three intervals. As the patient arrives at the larger proportions, they may with advantage be subdivided into the interval of a quarter or half an hour, which should be occupied in exercise." Tea at breakfast is directed to be avoided; and in cafes when the water disagrees at its natural temperature, it is recommended to be administered warm.

"On the first employment of the water, either cold or warm, some inconvenient sensations very commonly arise, such as flushing of the face, slight fulness of the head, with drowsiness and an uneasy dilution of the stomach, together with continued flatulence. In general these effects are not of importance, either in degree or duration, and are much to be prevented by previous attention to the stomach and bowels." — "As a general statement, it may be added, that the employment of this water is improper in a very plethoric state of the circulation; also when there is an inflammatory determination to any particular organ, or even when local congestion exists without inflammation. In cafes of simple debility of the constitution, the water promises to produce its happiest effects. The proofs of its immediately agreeing with the patient are increased appetite and spirits, and these auspicious symptoms are followed by a gradual improvement in the general energy and strength." The bowels usually become constipated under its use, and require the assistance of medicine. The warm bath is occasionally of service in conjunction with this water, as was long ago pointed out by Hoffmann. Exercise also after its use is generally of great importance. In dyspepsia depending on debility of the stomach, and accompanied with general languor and nervousness, this water is remarkably restorative. In uterine debility also, and chlorosis, its use is often of the utmost service. It has been much recommended likewise in some cutaneous affections. For the complaints of children, especially when young, (that is to say, under six or seven years of age,) it is not in general adapted, for reasons sufficiently obvious. A course of this water may vary from three weeks to two or three months, according to circumstances. b. With respect to the medicinal properties of waters containing the sulphates of iron and alumina, as the Isle of Wight and Hartfell waters above-mentioned, they differ little perhaps, except in degree, from those of the simple chalybeate waters. The Isle of Wight water is so strong, that it is always proper to dilute it at first with twice its quantity of common water; and even then the dose cannot well exceed two or three ounces, which may be gradually increased to about a pint in twenty-four hours. Dr. Saunders recommends the same quantity as the maximum dose of the Hartfell water. Both these waters are often much improved by being gently heated, especially in cafes where the stomach is very delicate and irritable. Dr. Lempriere, who has written a pamphlet on the Isle of Wight water, states, that he found it particularly serviceable in the debility induced by the Walcheren fever, chronic dysentery, &c., as well as in every infirmity when the constitution had been undermined by previous ills, and the ordinary tonics had failed. It is particularly necessary to guard against confinements during the use of these waters.

**Compound Chalybeate Waters.** These may be divided into a. **Saline chalybeate,** and b. **Acidulous chalybeate.**

a. The Cheltenham waters, properly so called, are a good example of the saline chalybeate. (For the history of these waters, see Cheltenham.) Since that article was written, however, several springs of different qualities and powers have been discovered by Mr. Thomson; an abstract of the composition and properties of which, as lately published, we shall now take the opportunity of laying before our readers.

The springs which have been described and analysed by Mefla. Brinde and Parkes are six, viz.,

1. The strong chalybeate saline water. Sp. gr. 1009.2.
2. The strong sulphuretted saline water. Sp. gr. 1008.5.
3. The weak sulphuretted saline water. Sp. gr. 1006.
5. The sulphuretted and chalybeated magnesia spring, or bitter saline water. Sp. gr. 1008.
6. Saline chalybeate, drawn from the well near the laboratory.

The following Table presents a view of the contents of a wine pint of these different springs.

<table>
<thead>
<tr>
<th>Springs</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Muriate of soda</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muriate of magnesia</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Sulphate of soda</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Sulphate of magnesia</td>
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<td></td>
</tr>
<tr>
<td>Sulphate of lime</td>
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<td></td>
</tr>
<tr>
<td>Carbonate of soda</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oxid of iron</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lofs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>74.0</td>
<td>65.0</td>
<td>36.0</td>
<td>80.5</td>
<td>60.0</td>
<td>34.0</td>
</tr>
<tr>
<td>Sulphuretted hydrogen</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbonic acid</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>2.5</td>
<td>4.0</td>
<td>4.0</td>
<td>0.0</td>
<td>5.5</td>
<td>10.0</td>
</tr>
</tbody>
</table>
The medicinal properties of these different springs of course vary according to their composition and strength. Mr. Thomfon, the proprietor, procures from them six different saline preparations, neither of which, however, is precisely similar to the water drank at the Spa. These he denominates, crystallized alkaline sulphates; ditto effloresced and ground to an impalpable powder for hot climates; magnesian sulphate in a state of efflorescence; a muriato-sulphate of magnesia and iron in brown crystals, highly tonic; sub-carbonate of magnesia in powder, and calcined magnesia.

b. As an example of the acidulous chalybeates, we may adduce the celebrated waters of Spa. (See Spa.) Dr. Jones has lately published an interesting paper on these waters, which contains, among other things, analyses of the different springs, of the results of which the following table presents a summary view.

| Table exhibiting the Nature and Proportion of the Substances contained in One Gallon of the respective Spa Waters. |
|-------------|-------------------|----------------|-------------------|-----------------|-----------------|-----------------|-----------------|
| Fountains   | Temperature       | Specific Gravity | Carbonic Acid Gas | Sulphate of Soda | Muriate of Soda | Carbon of Soda | Carbon of Magnesia | Oxyle of Iron |
| Pouhon      | 50                | 1.00008         | 262.0             | 26.8            | 0.92           | 1.26           | 2.45            | 9.87           | 1.80           | 5.24           | 2.26           | 0.29           | 2.71           |
| Geronfiere  | 49½              | 1.00008         | 168.5             | 12.50           | 0.62           | 0.64           | 1.43           | 5.20           | 1.05           | 0.94           | 1.40           | 0.19           | 1.03           |
| Sauviniere  | 49½              | 1.00075         | 241.4             | 8.50            | 0.05           | 0.25           | 0.60           | 3.50           | 0.69           | 2.10           | 0.40           | 0.10           | 0.90           |
| Groesbeek   | 49½              | 1.00075         | 265.0             | 5.90            | 0.05           | 0.15           | 0.30           | 2.40           | 0.20           | 1.55           | 0.60           | 0.10           | 0.55           |
| 1st Tonnelet| 49½              | 1.00075         | 282.0             | 5.30            | 0.06           | 0.15           | 0.20           | 1.10           | 0.30           | 2.70           | 0.60           | 0.10           | 0.09           |
| 2d Tonnelet | 49½              | 1.00075         | 260.5             | 3.70            | *              | *              | *              | *              | *              | *              | *              | *              | 0.35           |
| Watroz      | not afterwards    | 9.30            | 0.20              | 0.10            | 1.40           | 1.90           | 2.60           | 0.90           | 0.60           | 1.80           |                |                |                |
| The Pouhon, after much wet weather. | 32.3             | 0.80            | 0.95             | 2.0             | 13.82          | 3.97           | 4.45           | 3.27           | 0.38           | 3.68           |                |                |                |

* Quantity not appreciable.

With respect to the medicinal properties of the compound chalybeates, they are, as might be expected, of a mixed character, and usually correspond with the nature of the predominant impregnating ingredients; hence their properties will be readily understood from what has been advanced. For further particulars respecting the medicinal properties of the Cheltenham and Spa waters, we refer our readers to these articles.

4. Simple Acidulous Waters.—Under this denomination may be included all waters whose characteristic ingredient is an acid. They may be considered as two descriptions: a. Those impregnated with a volatile acid, as the carbonic and sulphurous acids; and b. Those containing a fixed acid, as the muriatic and sulphuric acids.

a. The waters of Seltzer may be adduced as an example of the first variety of acidulous waters. "Seltzer is a village situated in a fine woody country, about ten miles from Frankfort, and thirty-six from Coblenz, in a district which abounds with valuable mineral springs." This water has been examined by Hoffmann, Bergman, and others. When fresh from the well, it is perfectly clear and pellucid, and sparkles much when poured into a glas. Its taste is slightly pungent, but at the same time gently saline and alkaline. On exposure to the air for a short time, the carbonic acid escapes, and the alkaline taste becomes more perceptible. According to Bergman, an English pint contains of

<table>
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<tbody>
<tr>
<td>Carbonic acid upwards of</td>
<td>17</td>
</tr>
<tr>
<td>Carbonate of lime about</td>
<td>3</td>
</tr>
<tr>
<td>Carbonate of magnesia</td>
<td>5</td>
</tr>
<tr>
<td>Carbonate of soda</td>
<td>4</td>
</tr>
<tr>
<td>Muriate of soda</td>
<td>17.5</td>
</tr>
</tbody>
</table>
| Waters containing a free mineral acid in excess are very rare, and chiefly confined to volcanic countries. Mr. Garden has lately examined a water of this description from White Island, on the coast of New Zealand: it was of a pale yellowish-green colour; its odour resembled that of a mixture of muriatic and sulphuric acids. Its taste was strongly acid and styptic, like that of a chalybeate. Its specific gravity 1.073. On being submitted to analysis, its contents were found to consist chiefly of muriatic acid, a slight trace of sulphur, small proportions of alum, muriate of iron, and sulphate of lime. Waters impregnated with

C 2

f sulphuric
Sulphuric acid are sometimes met with likewise in the vicinity of volcanoes.

As to the medicinal properties of these waters, they probably differ little from those of a dilute solution of the different acids which they contain. For the particular properties of the Seltzer water, see Seltzer.

Compound Acidulous Waters.—Acidulous waters sometimes contain so large a proportion of saline matters, that the nature of their operation is considerably modified. Such waters may be denominated saline acidulous waters. The nature of their composition and medicinal properties will be readily understood from what has been already advanced.

5. Sulphureous Waters.—These are either simple or compound. A good example of a simple sulphureous water is the Moffat spring. The village of Moffat is situated in Dumfriesshire, on the banks of the Annan, about fifty miles south-west of Edinburgh. The sulphureous waters for which this village is noted, issue from a rock a little below a bog, whence, says Dr. Saunders, they probably derive their sulphureous ingredient. This water, even when first drawn, appears somewhat milky. It taints sulphureous, and slightly saline. It sparkles a little when poured from one glass into another. On exposure to the air, it becomes more turbid, and throws up a thin film, which is pure sulphur, and it loses its distinguishing properties as a sulphureous spring. This change even takes place in close vessels, so that it cannot be exported with any advantage. According to Dr. Garnett’s analysis, a wine pint of this water contains

<table>
<thead>
<tr>
<th>Cubic Inches.</th>
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<tbody>
<tr>
<td>Of sulphuretted hydrogen</td>
</tr>
<tr>
<td>Of carbonic acid</td>
</tr>
<tr>
<td>Of azote</td>
</tr>
<tr>
<td></td>
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</tbody>
</table>

And of muriate of soda 4.4 grains.

With respect to the medicinal properties of simple sulphureous waters, they have been always celebrated for their good effects in cutaneous affections in general, and also in icterus. They are applied externally in the form of a warm bath, as well as taken internally. They have been also recommended in bilious complaints, dyspepsia, general want of action in the alimentary canal, and calculous fevers. The quantity of the Moffat waters usually prescribed internally varies from one to three bottles every morning. But Dr. Saunders judiciously observes, that few delicate stomachs can bear so much. On the other hand, the same eminent physician informs us, that the common people not infrequently swallow from six to ten English quarts in one morning.

For further particulars respecting this spring, see Moffat.

Sulphurous waters frequently contain so considerable a proportion of saline substancess as to merit the name of compound. An example of such waters we have in the celebrated springs of Harrogate, in Yorkshire. (See Harrogate.) This water, when first taken up, appears perfectly clear and transparent. It emits a few air-bubbles. Its smell is very strong, sulphureous, and fetid, like that of a foul gun-barrel. Its taint is bitter, nauseous, and strongly saline; though it is remarkable that most persons soon become reconciled to it. On exposure to the air, it becomes turbid, the sulphureous odour is diminished, and the sulphur is gradually deposited. According to Dr. Garnett, its specific gravity is 1.0064. A wine pint, according to the experiments of the same chemist, was found to contain about

<table>
<thead>
<tr>
<th>Cubic Inches.</th>
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<tbody>
<tr>
<td>Of sulphuretted hydrogen</td>
</tr>
<tr>
<td>Carbonic acid gas</td>
</tr>
<tr>
<td>Azote</td>
</tr>
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</table>

And of

<table>
<thead>
<tr>
<th>Grains.</th>
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</thead>
<tbody>
<tr>
<td>Muriate of soda</td>
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<tr>
<td>Muriate of lime</td>
</tr>
<tr>
<td>Muriate of magnesia</td>
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<tr>
<td>Carbonate of lime</td>
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<tr>
<td>Carbonate of magnesia</td>
</tr>
<tr>
<td>Sulphate of magnesia</td>
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</tbody>
</table>

With respect to the medicinal properties of waters of this description, and particularly of Harrogate water, they are of the greatest use in all those complaints that require purgatives, and at the same time are benefited by sulphur; hence they have been long celebrated in cutaneous affections, in piles, worms, &c. They have also been found of great use in that obtrusive colitis habit of body which usually accompanies hypochondrias. Harrogate waters were formerly principally applied externally, but now they are generally recommended to be taken internally, in such doses as to produce a sensible effect upon the bowels; for which purpose it is common necessity to take in the morning three or four glasses, of rather more than half a pint each, at moderate intervals.

6. Thermal Waters.—There is something so mysterious and remarkable in the circumstances of thermal springs, that they have in all ages attracted great attention, and been supposed to possess extraordinary medicinal properties. Hence, by most writers on mineral waters, thermal springs have been arranged under a distinct head; and as there appears to be no serious objection to this arrangement, we have thought proper to adopt it. The investigation of the cause of thermal springs belongs to the geologist, and will be found under Earth, Hot Springs, Temperature, Volcano, and analogous articles. They may be divided into simple and compound. Simples thermal waters are either tepid, that is, posseffing a temperature below that of the human body; or warm, possessing a temperature above that point. A good example of the simple tepid waters are those of Buxton. (See Buxton Water.) Tepid waters usually occur in lime-flone districts. Warm waters of every degree of temperature, even to the boiling point, are occasionally met with in the neighbourhood of volcanoes. See Volcano.

With respect to the medicinal properties of the simple thermal waters, it is extremely doubtful if they posseff any other powers than those of common water artificially raised to the same temperature.

Thermal springs are liable to be impregnated with all the different substancess which usually enter into the composition of cold mineral waters; hence they are very various in their nature. Such thermal waters may be called compound, and without any great facric of the principles of arrangement we have adopted, may be comprised under three heads; namely, a. Saline thermal waters, b. Acidulous thermal waters, and c. Sulphurous thermal waters;
WATER.

waters; each of which varieties may be either tepid or warm.

a. Thermal waters simply saline are very rare. Their properties can in no respect be supposed to differ from cold saline waters raised to the same temperature. Sea-water, therefore, heated artificially, is a good example of this variety. It is generally used externally as a bath. See BATHING.

b. A good example of the acidulo-calcareous thermal waters we have in the springs of Carlbad. For a full account of the chemical properties of these springs, see CARLSBAD.

c. The celebrated waters of Aix-la-Chapelle, or Aken, afford a good example of the fulphurous thermal waters. See AIX-LA-CHAPELLE.

With respect to the medicinal properties of the compound thermal waters, they have all been in much request as baths, which was, perhaps, the original mode in which the two last varieties in particular were employed. In later times, they have been much used internally. The difeases, says Dr. Saunders, to the cure of which the internal use of Carlbad waters are applicable, are as various as the nature of their foreign contents; and from the union of several valuable qualities in one water, it may be made use of in cases of very opposite natures, without incurring the cenure of employing it indifferently as an universal medicine. In common with the other purgative chalybeates, it is found to be eminently serviceable in dysepsia and other derangements of the healthy action of the stomach, in obstructions of the abdominal vicera, not connected with great organic difeafe, and in defect or depravation of the biliary secretion. It is also of use in calculous affections, and is highly esteemed for restoring the utterine fyltem to a healthy state. The fame precautions against its internal use in phlethoric and irritable habits, and those who are subject to hæmoptysis, or liable to apoplexy, require to be observed here as with any of the other active thermal waters. The Aix-la-Chapelle waters, taken internally, are likewise found essentially serviceable in the numerous symptoms of disorders in the stomach and biliary organs, that follow a life of high indulgence in the luxuries of the table. It also much relieves painful affections of the kidneys and bladder. The fame precautions in its use are to be attended to, as those above-mentioned respecting the Carlbad waters. For the external uses of those waters, see BATHING, and the articles CARLSBAD and AIX-LA-CHAPELLE, before referred to.

Our readers will readily perceive, from the above fyliematic sketch, that the infinite variety which exists among mineral waters absolutely precludes a perfect arrangement of them: we trust, however, that no mineral water can occur which may not be referred to one or other of the above heads or their subdivisions, without any great sacrifice of our principles of arrangement; and, consequently, whose general medicinal properties cannot be estimated with tolerable accuracy a priori from its chemical composition.

On the general Uses of Water in a dietetic and medicinal Point of View.—No organic procers nor interchange of elements can be supposed to take place without the intervention of a fluid; organized beings, therefore, contain a large proportion of fluid in their composition, through the medium of which that endless series of changes, essential to their existence, is principally effected. The basis of this fluid is universally water, which of all other fluids is the most eminently fitted for dissolving and holding in solution every variety of animal and vegetable matter. See Food of Plants.

In animals, the first great step in the series of vital processes is digestion; and here nature appears to render the presence of a fluid particularly necessary, in order, as it were, to procure for her self, a sufficiency for her future operations. Accordingly, we find that all animals instinctively take in a certain proportion of fluid, either in the form of simple water, or succulent food. Man alone is the only animal accustomed to swallow unnatural drinks, or to abuse those which are natural; and this is the fruitful source of a great variety of his bodily and mental evils.

We know little of the intimate nature of the digestive processes, but we know that it is chiefly effected by means of a highly animalized fluid secreted by the stomach itself. Now this important fluid, by drinking too little or too much, or by other causes, may be rendered too concentrated or too dilute for the due performance of its operations; and dysepsia, and all its concomitants, may thus ensue from habitual errors in the quantity of drink only. The remedy in such cases is obvious, and consists perhaps in nothing more than in duly regulating the quantity of watery aliment, as dictated by instinct, or the feuARATION of thirst only.

An eminent modern physiologist recommends to abate from drinking during meals, and for some time afterwards; and as a general rule, this may, perhaps, be proper, since a healthy stomach may be supposed to be always able to secrete fluid enough for its own immediate operations: there can be no doubt, however, but many exceptions to this rule may be met with, arising either from the nature of the food or condition of the stomach, in which moderate dilution is not only grateful but salutary.

With respect to the choice of water as an article of diet, (for our readers will understand that we speak of water only in this place,) those which are hard and impure have long lain under the imputation of producing calculous affections; and we have good authority for什么样, that, in many instances, the use of such waters actually increases the painful symptoms of these distressing complaints. It is not perhaps an easy task to explain this, since, with the exception of lime, the substances found in hard waters never enter into the composition of calculi; their operation, therefore, must be rather of a predisposing nature, and is probably exerted upon the organs of digestion, which are well known to be intimately connected with the kidneys. A fact which renders this opinion the more probable is, that hard waters are often positively noxious to irritable stomachs, by inducing dysepsia. In short, pure water, as we formerly observed, must obviously be much better adapted for the important purposes of dilution and solution, than water already watered as it were with foreign substances; and upon this principle may probably be satisfactorily explained the good effects of Malvern and other waters, whose only characteristic property is, their remarkable degree of purity.

In a medicinal point of view, the use of water as a diluent is most important; and as Dr. Saunders justly observes, the long lift of piftias, decoctions, &c. usually prescribed by physicians in acute diseases, owe their virtues almost entirely to the watery diluent itself.

The instinctive desires or aversions, continues the same eminent writer, of persons labouring under any species of dispersed functions, have been justly considered as deriving the highest attention from the physician, and in most cases will furnish him with useful hints for his treatment of the patient. In acute diseases, the thirst after water is particularly remarked as a characteristic symptom, and is a direct instinctive indication of increased heat and want of dilution; and this is so uniform, that the degree of fever may often be pretty well estimated by the eagerness of the sufferer after cold drink. The benefits arising from large dilution in acute diseases, however, are not confined to the mere
WATER.

mere quenching of thirst, though this is in itself highly advantageous; but it is after so much liquid is added to the circulating mass, that the truly diluent effects are produced. These confit, in Dr. S.'s opinion, in diminishing the morbid heat and violence of reaction in the solids; in preserving all the secreting organs in a perverso state; and in checking that tendency to spontaneo change, which renders the fluids positively noxious to the vessels in which they are contained, and unfit to perform those functions, on which the health of the body so essentially depends.

It appears probable, however, in the opinion of the same author, to carry dilution in active fever to excess. In fever, as is well known, the exhalent vessels are comparatively inactive, or morbidly contracted, and the secretion of urine is defective in quantity. In such cases, if it is often better to take liquids in small divided doses, which has the effect of moderating the thirst, without overloading the arterial syslem, and bringing on that tension and plenitude liable to be produced by swallowing too large a proportion of liquids.

In the use of water in acute diseases, the temperature should be particularly attended to. As a general rule it may be laid down, that the temperature of diluents at the different periods of a cold, hot, and sweating stage of a simple febrile paroxysm, should be hot in the first stage, cold in the second, and tepid in the third; and it is chiefly in the second stage that the quantity may be most liberal.

Molt of the above remarks are equally applicable to the use of water in chronic diseases in general, but more especially in the deranged functions of the stomach and bowels and biliary organs, occasioned by a long and habitual indulgence in high food, strong drink, and all the luxuries of the table, and which are well known to be so decidedly benefited by the use of water as a medicine. As in acute diseases, so in chronic affections likewise, it is often of great importance to attend to the temperature of the water. A draught of cold water, for example, will often induce sickness and other dilating symptoms in delicate dyspeptic habits, while water rendered slightly tepid may be taken with impunity and even advantage. On the other hand, the habitual use of warm water or drinks is to be avoided, and doubtless always does much harm.

We shall close these remarks by a quotation from Dr. Saunders on the habitual use of water. "Water-drinkers," says this eminent writer, "are in general longer livers, are less subject to decay of the faculties, have better teeth, more regular appetites and less acid evacuations, than those who indulge in a more stimulating diluent for their common drink."

For the external uses of water, see the articles Bath and Bathing, where this part of the subject is treated at length.

On the general Contents of Mineral Waters and their Operation.—The proportions of saline and other ingredients in mineral waters are for the most part so small, as apparently to be insufficient for explaining the effects they often produce upon the animal economy. Many attempts, therefore, have been made to explain this circumstance by different writers, and the subject is so interesting, that we cannot let it pass without making a few remarks upon it.

Dr. Saunders, one of the latest and best writers on mineral waters, very properly ridicules the idea of specific and other mysterious properties, by which the older authors attempted to explain their operation. This intelligent physician supposes, that a very great proportion of their effects depends chiefly upon the diluent operation of the water itself. Of this, as we formerly observed, there can be no doubt, in many instances; and even in all, the mere bulk and temperature of the water must be allowed to produce a certain proportion of the effects. Still, however, innumerable instances occur, in which these are insufficient to explain the whole, even when aided by the additional circumstance of great dilution, on which the above eminent physician likewise lays great stress. The matter, therefore, has always appeared sufficiently puzzling, and it is only lately that a little light has been thrown upon it by the ingenious views of Dr. Murray, which will be more fully explained in the next section.

There can be no doubt that soluble salts in general are capable of exerting a much more powerful effect upon the animal economy, ceteris paribus, than those which are insolu-ble. The muriates are the most soluble class of salts occurring in waters, and are moreover, independently of this, the most active; at least, this is the case with the earthy muriates, especially the muriate of lime. Now this salt, Dr. M. has rendered it probable, exerts in all mineral waters found by the usual analytic method to contain the sulphate of lime and muriate of soda, which comprehend by far the greater number. The same ingenious author has also rendered it probable, that iron not unfrequently exisits in the state of muriate instead of carbonate, as commonly believed, as for example, in the Bath waters. With these views in general we perfectly coincide, and have no doubt that, in many instances, a large proportion of the good effects of mineral waters arises from the muriates they contain; but we must confess that many difficulties still appear to us to remain on this obscure subject, which cannot, in the present state of our knowledge, be satisfactorily explained.

Analysis of Mineral Waters.—The analysis of mineral waters has been fully done one of the most difficult problems in practical chemistry. This arises partly from the diversified nature of the ingredients, and partly from the minute proportions in which some of them exist. The celebrated Bergman was the first chemist who presented the world with a general method or formula for analyzing mineral waters. This was esteemed excellent in its day, and even at the present time may be considered valuable. Twenty years afterwards, Mr. Kirwan published an essay on the subject, which not only comprified all that had been previously done, but contained many valuable additions made by himself. He also proposed a new method of analysis, of which we shall give a short account hereafter.

a. The first step in the examination of a mineral water, is to notice accurately its febile properties, such as its temperature, colour, transparency, taste, smell, &c.

b. The second step is to ascertain its specific gravity, the spontaneous changes it undergoes on exposure to the air, the application of heat, &c.

c. These preliminary operations being performed, the next object of inquiry, is to endeavour to obtain a knowledge of the different ingredients present by means of reagents, or tests, as they are usually termed. We have already mentioned the different ingredients commonly met with in mineral waters, and shall now proceed to give a list of the different tests by which their presence may be detected. For this list we are chiefly indebted to Dr. Thomson, who has compiled it from Kirwan and others.

1. The Gaseous Substances may be separated from water, by boiling it in a retort connected with a pneumatic apparatus, and their nature and proportions may be ascertained in the manner to be presently described.

2. Hydrogen and its Compounds.—Sulphuretted hydrogen is readily distinguished by its peculiar smell, by its reddening litmus fugaciously, and by its blackening paper dipped in fo-
WATER.

3. Atmospheric Air: Oxygen and Azote.—The preference of oxygen gas may be known by its power of supporting combustion, and by the diminution which takes place on mixing it with nitrous gas or phosphorus. There is no test for azote, but it is sufficiently characterized by its negative properties.

4. Alkalis and Alkaline Earths.—The alkalis and alkaline earths, as well as their carbonates, are distinguished in general by the following tests. Turmeric paper is rendered brown by alkalis, or reddish-brown, if the quantity be minute. Brazil wood is rendered blue not only by the alkalis, but also by the alkaline and earthy carbonates. Limus paper reddened by vinegar is restored to its original colour by alkalis, and also by the alkaline and earthy carbonates. If these changes are fugacious, we may conclude that the alkali is ammonia. Fixed alkalis are indicated when a precipitate is produced by muriate of magnesia after being boiled. The volatile alkali, or ammonia, may be readily distinguished by its sensible properties. The earthy and metallic carbonates are precipitated by boiling the water containing them, except carbonate of magnesia, which is only precipitated imperfectly. With respect to the individual substances of this class—Potash may be distinguished by the precipitate it produces with the muriate of platinia, the sulphate of alumina, and tartaric acid. For soda there is no good test, but its falls are easily distinguished from those of potash. Ammonia may be known from its odour and other properties above-mentioned. Lime is detected by means of the oxalic acid, which occasions a white precipitate. To render its operation certain, however, the mineral acids, if present, must be separated with an alkali. Magnesia and alumina. Pure ammonia precipitates both these earths and no other, provided the carbonic acid has been previously separated. Lime-water also precipitates only these two earths, provided the carbonic and sulphuric acids be previously removed. The alumina may be separated from the magnesia by boiling the precipitate in pure potash, which dissolves the alumina and leaves the magnesia. Silica may be ascertained by evaporating a portion of the water to dryness, and redissolving the precipitate in muriatic acid. The silica remains behind undissolved. Copper is occasionally met with in waters. It may be detected by the fine blue colour produced on the addition of ammonium, by the red-coloured precipitate produced by the prussiate of potash; or it may be obtained in the metallic state by plunging into the water a piece of polished iron. Lead is sometimes found in waters that have traversed leaden pipes. Such waters are blackened by a current of sulphuretted hydrogen gas; but to render the presence of the metal more certain, a portion of the water is to be evaporated to dryness; the remainder is to be tefled with nitric acid, and afterwards tefted with solutions of the carbonate and sulphate of potash, which produce white precipitates, from which the lead may be readily obtained in the metallic state.

6. Acids.—Carbolic acid, in a free or uncombined state, may be detected by lime-water, which occasions a precipitate soluble with effervescence in muriatic acid; or by the infusion of limus, which is reddened, but becomes again blue on exposure to the air. Water containing free carbolic acid loses this property of reddening limus by boiling. The sulphuric acid is readily distinguished by the muriate, nitrate, or acetate of barytes, frottant, and lime, and also by the nitrate or acetate of lead. The most delicate of these tests is the muriate of barytes: this produces a white precipitate, insoluble in muriatic acid. To ensure the operation of this test, it is necessary that no earthy or alkaline combination be present in the water. The muriatic acid is detected by the nitrate of silver, which occasions a white curdy precipitate, insoluble in nitric acid. To ensure the operation of this test, the alkaline and earthy carbonates must be previously saturated with nitric acid; and the sulphuric acid, if any be present, must be separated by the nitrate of barytes. Boraxic acid is detected by means of the acetate of lead. The precipitate formed is insoluble in acetic acid. To render this test certain, the alkalis and earths must previously be saturated with acetic acid, and the sulphuric and muriatic acids removed by means of the acetate of frottant and the acetate of silver.

Such is a brief account of the different tests usually employed to detect the ingredients present in mineral waters, and the most obvious precautions to be observed in their use. It is proper, however, to observe, that there are many circumstances to be attended to, in the use of tests in general, which can only be learnt by personal observation and practice, and that the inexperienced chemist is very liable to be misled by them.

d. Having thus acquired, by the employment of tests, a general knowledge of the ingredients contained in a mineral water, the next object is to endeavour to ascertain the quantities and modes of combination in which they exist; and this constitutes by far the most difficult part of the inquiry.

There are two general modes of conducting the analysis of a mineral water: one is to separate, by various appropriate manipulations, the different ingredients in the same compound forms in which they are supposed to actually exist in the water. The other, recommended particularly by Dr. Murray, is to ascertain, chiefly by means of tests, the quantities of the different simple substances, and afterwards to estimate from them the quantities of the compounds. The first of these modes, and in some influences a combination of both, is the one which has hitherto been generally adopted by chemists; we shall, therefore, give a short account of the manipulations had recourse to for separating a few of the substances most usually occurring in mineral waters.

1. The gaseous matters are first to be separated in the manner formerly mentioned, and their gross amount ascertained by admeasurement in a jar graduated into cubic inches. Sulphuretted hydrogen, if it be present with other gases, is first to be separated by immersing the jar in warm water, and introducing nitric acid, which absorbs the sulphuretted hydrogen, and the diminution of bulk denotes its quantity.
WATER.

quantity. If sulphurous acid be present, the above step is unnecessary, for sulphuretted hydrogen never exists in water containing this acid. Sulphurous acid may be separated by introducing into the gaseous mixture a quantity of the peroxys of lead, in a state of powder. This will gradually absorb the whole, and the diminution of bulk, as before, will denote its quantity. The introduction of a little potash, after this, will absorb the carbonic acid. The remaining gases must be oxygen and azote. The oxygen may be separated by introducing a piece of phosphorus, or by other well-known eudiometrical means; and the azote will remain half of all, unaffected by any of these processes.

2. The earthy carbonates, if any be present, are first to be separated by boiling a given portion of the water for a quarter of an hour. The precipitate thus obtained may consist of a mixture of the carbonates of lime, of magnesia, of iron, and of alumina, and even of the sulphate of lime. Supposing all these to be present, the precipitate is to be treated with dilute muriatic acid, which will dissolve the whole, except the alumina and sulphate of lime. Dry this residuum in a red heat, and note the weight. Then boil it in a solution of carbonate of soda; saturate the soda with muriatic acid, and boil the mixture for half an hour; carbonates of lime and alumina will be precipitated; the lime may be then dissolved by acetic acid, while the alumina will remain; and thus the weight of each may be ascertained.

The muriatic solution contains lime, magnesia, and iron. To separate these, add ammonia, which will precipitate the iron and part of the magnesia. Dry the precipitate, and expose it to the air for some time in a temperature of about 200°. The magnesia may be then separated by acetic acid, and the acetic thus formed is to be added to the muriatic solution. The iron is now to be re-dissolved in muriatic acid, precipitated by an alkaline carbonate, and dried and weighed.

Muriate of lime and magnesia still remain in solution. To separate them, add sulphuric acid as long as any precipitate appears, then heat the solution, and concentrate. The sulphate of lime thus obtained is to be heated to redness, and its weight ascertained. Lastly, the magnesia may be separated by an alkaline carbonate, or what is much better, by the phospate of ammonia.

3. To ascertain the quantity of the alkaline carbonates, supposing them to exist in waters, determine how much of any dilute acid, whose strength has been previously carefully ascertained, is necessary to saturate them; and from this the quantity of alkali can be readily estimated.

4. The alkaline and earthy sulphates may be estimated by the following methods.

The alkaline sulphates may be determined by precipitating their acid by means of the nitrate of barytes, having previously separated all the earthy sulphates.

Sulphate of lime is readily estimated by evaporating the water to a few ounces, the earthy carbonates being previously saturated with nitric acid, and precipitating the sulphate of lime by means of dilute alcohol.

If the sulphate of magnesia or alumina be the only sulphate present, the quantity of either can be readily estimated. If they exist together, the two earths may be precipitated by soda, and afterwards separated by acetic acid in the manner above-mentioned. If sulphate of lime be also present, this may be previously separated in a great degree, as above; or, what is preferable, the lime may be precipitated by an alkali along with the other earths, and afterwards separated. The same holds good also with the sulphate of iron; or the iron may be separated by expounding the water for some days to the air, and mixing with it a portion of alumina. The oxvd of iron and sulphate of alumina are precipitated together, and may be easily separated, and the quantity of iron ascertained.

5. If muriate of potash or soda exist alone in water, its quantity can be readily estimated by precipitating the muriatic acid with the nitrate of silver. The same process may be followed, if the alkaline carbonates be present; only the earths must be previously saturated with sulphuric acid, and, instead of using the nitrate, the sulphate of silver is to be employed.

If the alkaline muriates exist along with more or less of the earthy muriates, or with the muriate of iron, without any other salts, the whole of the earths may be separated by barytes water, and their quantities estimated as before. To discover the proportion of the alkaline muriates, the barytes is to be separated by sulphuric acid, and the muriatic acid expelled by heat. The quantity of the alkaline muriates may be then ascertained by evaporation.

When sulphates and muriates exist together, they may be separated by evaporating the whole to dryness, and diluting the earthy muriates in alcohol; or, when the water has been duly concentrated, by precipitating the sulphates with the same fluid.

When alkaline and earthy muriates exist with sulphate of lime, this last salt is to be decomposed by means of the muriate of barytes. The estimation is then to be conducted as if nothing but muriates are present, only the proportion of muriatic acid which united in the muriate of barytes, added, must be allowed for.

When muriates of soda, magnesia, and alumina, are present, together with sulphates of lime and magnesia, the water is better examined by two distinct operations. To one portion add carbonate of magnesia, till the whole of the lime and alumina be precipitated. Ascertain the quantity of lime, which gives the proportion of sulphate of lime. Precipitate the sulphuric acid by muriate of barytes; this gives the quantity contained in the sulphate of magnesia and sulphate of lime; and the quantity of sulphate of lime being previously known, that of the sulphate of magnesia can be easily estimated. To a second portion of the water add lime-water, till the whole of the magnesia and alumina be separated. From the weight of these earths the quantity of their muriates may be estimated; that portion of the magnesia previously found to be in union with sulphuric acid must be deducted. After this, remove the sulphuric acid by barytes water, and the lime by carbonic acid, and the liquid evaporated to dryness will leave the common salt.

6. Lastly: If the fixed mineral acids should alone be found to exist in a water, it need scarcely be observed that their quantities can be readily ascertained; the sulphuric acid by means of a barytic salt, and the muriatic acid by means of a salt of silver.

All these different precipitates should be dried uniformly, or at least at some known degree of temperature. It is not easy to fix this point, which must in a great degree be regulated by the nature of the salt, and the peculiar views of the analyst; some choosing to reduce the salts to an anhydrous, others to a crystallized state. As a sort of check also to the analysis, it is proper to evaporate a known quantity of the water to dryness, in order to learn the gross amount of the saline matters it contains, which amount is to be compared with the results as obtained by the different processes of the analysis.

Such are a few of the most common methods recommended for separating and ascertaining the proportions of the different
different saline substances contained in a mineral water. They
must of course be varied according to circumstances; but this, as well as the application of other methods, must
depend upon the practical knowledge and judgment of the
anlyst.

The principles, however, upon which many of the above
analytical processes are founded, have been lately called in
question by Dr. Murray of Edinburgh, and we think very
justly. That gentleman has endeavoured to shew, that we
by no means arrive at a just knowledge of the constituents of
a mineral water by these processes, and that many of the
compounds obtained by them are determined by the pro-
cesses themselves. The following quotation, from a paper
by Dr. Murray, entitled "A general Formula for the
Analysis of Mineral Waters," in the eighth volume of the
Transactions of the Royal Society of Edinburgh, will con-
vey a distinct idea of his opinions and mode of reasoning
upon the subject.

Two methods of analysis have been employed for dis-
covering the composition of mineral waters, what may be
called the direct method, in which, by evaporation, aided by
the subsequent application of solvents, or sometimes by
precipitants, certain compound salts are obtained; and what
may be called the indirect method, in which, by the use of
reagents, the principles of these salts, and bales of which
they are formed, are discovered, and their quantities esti-
imated, whence the particular salts and their proportions
may be inferred.

Chemists have always considered the former of these
methods as affording the most certain and essential informa-
tion. They have not neglected the latter, but they have usu-
ally employed it as subordinate to the other. The salts pro-
cured by evaporation have been uniformly considered as the
real ingredients; and nothing more was required, therefore,
it was imagined, for the accuracy of the analysis, than the
obtaining them pure, and estimating their quantities with
precision. On the contrary, in obtaining the elements
merely, no information, it was believed, was gained with
regard to the real composition; for it still remained to be
determined in what mode they were combined: and this, it
was supposed, could be inferred only from the compounds
actually obtained. This method, therefore, when employed
with a view to estimate quantities, has been had recourse to
only to obviate particular difficulties attending the execution
of the other, or to give greater accuracy to the propor-
tions, or, at further, when the composition is very simple,
confifting chiefly of one genus of salts.

Another circumstance contributed to lead to a preference
of the direct mode of analysis—the uncertainty attending
the determination of the proportions of the elements of the
compound salts. This uncertainty was such, that even
from the most exact determination of the absolute quantities
of the acids and bases existing in a mineral water, it would
have been difficult, or nearly impracticable, to allign the
precise composition and the real proportions of the com-
 pound salts: and hence the necessity of employing the direct
method of obtaining them.

The present state of the science leads to other views.
If the conclusion was just, that the salts obtained by eva-
poration, or any analogous procefs from a mineral water,
are its real ingredients, no doubt could remain of the su-
periority of the direct method of analysis, and even of the
absolute necessity of employing it. But no illuminations, I
believe, are required to prove that this conclusion is not ne-
cecessarily true. The concentration by the evaporation muft,
in many cases, change the state of combination; and the salts
obtained are hence frequently products of the operation, not
original ingredients. Whether they are so or not, and what
the real composition is, are to be determined on other
grounds than on their being actually obtained; and no more
information is gained, therefore, with regard to that com-
position, by their being procured, than by their elements
being discovered; for when these are known, and their
quantities are determined, we can, according to the prin-
ciple from which the actual modes of combination are in-
erred, whatever this may be, align with equal facility the
quantities of the binary compounds they form.

The accuracy with which the proportions of the con-
stituent principles of the greater number of the compound
tsalts are now determined, enables us also to do this with as
much precision as by obtaining the compounds themselves; and
if any error should exist in the estimation of their propor-
tions, the prosecution of these researches could not fail soon
to discover it.

The mode of determining the composition of a mineral
water, by discovering the acids and bales which it contains,
admits in general of greater facility of execution, and more
accuracy, than the mode of determining by obtaining infu-
lated the compound salts. Nothing is more difficult than to
effect the entire separation of salts by crystallization, aided
even by the usual methods of the action of alcohol, either as
a solvent or a precipitant, or by the action of water as a
solvent at different temperatures: in many cases, it cannot
be completely attained, and the analysis must be deficient in
accuracy. No such difficulty is attached to the other
method. The principles being discovered, and their quantities
estimated in general from their precipitation in insoluble
compounds, their entire separation is easily effected. No-
thing is easier, for example, than to estimate the total
quantity of sulphuric acid by precipitation by barities, or
of lime by precipitation with oxalic acid; and this method
has one peculiar advantage with regard to accuracy, that if
any error is committed in the estimation of any of the prin-
ciples, it is discovered in the subsequent step of inferring the
binary combinations: since, if all the elements do not bear
that due proportion to each other, which is necessary to
produce the state of neutralization, the excess or deficiency
becomes apparent, and of course the error is detected.
The indirect method, then, has every advantage over the
other, both in accuracy and facility of execution.

Another advantage is derived from these views, if they
are just, that of precluding the discussion of questions, which
otherwise fall to be considered, and which must often be of
difficult determination, if they are even capable of
being determined. From the state of combination being
liable to be influenced by evaporation, or any other analytic
operation, by which the salts existing in a mineral water are
attempted to be procured, discordant results will often be
obtained, according to the methods employed: the propor-
tions at least will be different, and sometimes even products
will be found by one method, which are not by another.
In a water which is of a complicated composition, this will
more peculiarly be the case. The Cheltenham waters, for
example, have in different analyses afforded results consider-
ably different: and on the supposition of the salts procured
being the real ingredients, this variety must be ascribed to
inaccuracy; and ample room for discussion with regard to
this is introduced. In like manner, it has often been a sub-
ject of controversy whether sea-water contains sulphate of
foda with sulphate of magnesia. All such discussions, how-
ever, are superfluous. The salts procured are not neces-
arily the real ingredients, but in particular, are products
of the operation; liable, therefore, to be obtained or not,
or to be obtained in different proportions, according to the
method

Vol. XXXVIII.
method employed: and all that can be done with precision is to estimate the elements, and then to exhibit their binary combinations, according to whatever may be the most probable view of the real composition.

The method proposed by Mr. Kirwan, formerly alluded to, consists in determining, chiefly by tests, the quantity of the different saline substances present. But the complicated nature of many of the formulae, besides the very principle of the method itself, being liable to moat of the objections above urged by Dr. Murray against that in common use, renders its application difficult, and results uncertain. Upon the whole, therefore, we have no hesitation in saying, that we consider Dr. Murray's views and methods as by far the best, and most likely to lead to correct conclusions, that have yet appeared, and which may be stated in few words, as follows:

"Determine by precipitants the weight of the acids and bases present in a mineral water. Suppose them united in such a manner that they shall form the most soluble salts: these salts will constitute the true saline constituents of the water under examination."

Dr. Murray illustrates his method of procedure by supposing, as an example, a water found, by the usual tests, to contain the carbonates, sulphates, and muriates of lime, magnesia, and soda. The water is to be reduced by evaporation as far as can be done, without occasioning any sensible precipitation or crystallization. A saturated solution of muriate of barytes is then directed to be added as long as any precipitate falls, and no longer. This precipitates the whole of the sulphuric and carbonic acids, and the carbonate of barytes is to be separated from the sulphate by diluted muriatic acid. Add to the residual liquor a solution of oxalate of ammonia as long as any turbid appearance is produced. By this the whole of the lime is separated. The oxalate of lime is to be calcined, and converted into sulphate of lime, from which the quantity of pure lime may be readily estimated. The next step is to precipitate the magnesia; and for this purpose, Dr. Murray recommends a modification of Dr. Wollaston's process. This consists in adding, first, a solution of neutral carbonate of ammonia, and afterwards a strong solution of phosphoric acid, or phosphate of ammonia; taking care to leave an excess of the carbonate of ammonia. By these processes, the whole of the magnesia is obtained in the state of triple phosphate, and its quantity can be readily estimated. Muriate of soda now remains in solution, and its quantity can be obtained by evaporation. As a check, however, to the different processes, it may be proper to ascertain the quantity of muriatic acid present by means of the nitrate of silver.

If alumina, silica, or iron be present, they are best separated by distinct processes, in the manner formerly described.

Last ill, Dr. Murray recommends that the results of an analysis be stated in three modes: 1st. The quantities of the acids and bases; 2dly. The quantities of the binary compounds, as inferred from the principle that the most soluble compounds are the ingredients; and 3dly. The quantities of the binary compounds, such as they are obtained by the usual modes of analysis. The results will be thus presented in every point of view. As an instance of this method of stating the results of an analysis, we refer our readers to what we have said on sea-water in the present article.

Mineral Waters, artificial Preparation of.—Chemistry had no sooner developed the composition of mineral waters, than it suggested methods of preparing them artificially. Accordingly, Bergman and others have given many formulae for this purpose, some of which approach the truth, while others are very imperfect. When the composition of a water is very simple, nothing more is required to form it artificially than to know the nature and quantity of the saline substances present, and to dilute similar quantities of the same saline substances in the same proportion of water. In the earlier periods of chemical investigation, before the nature of gaseous substances was understood, no attempts of course could be made to imitate the important clafs of waters which derive their chief properties from the presence of such substances; but chemists no sooner became acquainted with the nature of gases, than they began to devise methods of imitating these alo; and artificial carbonated waters have been long since prepared as an article of commerce, under the name of foda water, superior in point of impregnation to any acidulous waters known. See PYRMON'T.

It is true that there are some instances of natural chemical solution, which art has not even yet been able to imitate. Of this kind is the solution of flies, which occasionally occurs in mineral waters. It is doubtful, however, if this earth is capable of exerting any salutary effects on the animal economy; and, therefore, we have little occasion perhaps to regret our inability to effect its solution. Another defect in the formation of artificial mineral waters is, that many of the more important ones cannot be obtained in large quantities for bathing, &c. without great a degree of expense and trouble, as to entirely preclude their use.

On the other hand it seems plausible, in theory at least, that we can improve upon the composition of many mineral waters. Thus, many mineral waters contain ingredients, which, either from the minuteness of the proportion in which they exist, or from their inert nature, may be deemed as superfluous, or in some instances as injurious. Again, others contain their active ingredient in such small quantities, as to require an inconvenient bulk of the water to produce the desired effect: all which defects may be remedied in the artificial preparation, by leaving out the useless or noxious matter, and increasing that in which the proper medicinal virtue resides. Besides these advantages also, we have it in our power to form new and valuable compounds, which are nowhere to be met with in a natural state.

The first step to the artificial formation of a mineral water is, of course, to know the exact composition of the water we would imitate. Many of the ingredients, however, obtained from mineral waters by the usual modes of analysis, are very little soluble in water: such, for example, are the sulphate and carbonate of lime, &c. which we should attempt in vain to dissolve directly in water. Other modes, therefore, must be devised for this purpose; and Dr. Murray's views of the composition of mineral waters in general will enable us to effect our object, in most instances, very readily and completely, as the following example will shew.

Suppose we wished to imitate the Seltzer water, an English pint of which, according to Bergman's analysis, contains, as before mentioned, of

| Carbonic acid         | -     | 17 |
| Carbonate of lime     | -     | 3  |
| Carbonate of magnesia | -     | 5  |
| Carbonate of soda     | -     | 4  |
| Muriate of soda       | -     | 17.5 |
|                        |      | 29.5 |

Catalogue of the most important mineral Waters.—The following catalogue is intended to comprise the principal mineral waters of Great Britain, and some of the more important ones of other countries. Our readers will recollect that, in the preceding articles, we divided natural waters into potable, saline, chalybeate, acidulous, fulphureous, and thermal, and described the general chemical and medicinal properties of each class, as well as of their compounds. To prevent repetition, and to save room, therefore, we have attempted to refer the different springs, mentioned in the following catalogue, to one or other of the above classes; thus, when a spring is stated to be saline, its general composition and properties are to be understood at ref. the class of saline waters; and so of the rest.

The moderns have very properly exploded the old notion of the mysterious and specific operation of particular springs. But even if this cogent reason for generalization did not exist, it would be impossible, in a work of the present description, to descend to all the minutiae of analysis, &c. supposing them to be known, which is far from being the case; we have thought proper, however, to give a few of the more interesting and instructive recent analyses of some of the most important springs.

Those springs marked thus *, in the following list, are more particularly described in the preceding article, as examples of the different classes.

Abercroy. An acidulous chalybeate spring. See Abzreyc.

Aberbithick, or Arbroath. An acidulous chalybeate spring. See Aberbithick.

Aberdour. A saline spring. See Aberdour.


Aberdovey, Leitrim. A weak sulphureous spring slightly saline.

Aberfeldy, Perth. A sulphureous spring slightly saline.

Aberford. A saline spring. See Aberford.

Aberglasburn, near Glasgow. A saline spring. See Aberglasburn.

Aberhard, near Bal Harbour. A saline spring. See Aberhard.

Aberdeen, Yorkshire. A strong sulphureous spring slightly saline.

Abercrombie, Lincolnshire. A saline chalybeate spring. See Abercrombie.

Aberdeenshire. Wellmeath. A chalybeate spring slightly saline.

d'Arzon, France. Sulphureous thermal springs, in much repute as baths.

Baden. Sulphureous springs, formerly in much repute as baths. See Baden.

Bagnoles. Two springs, one saline, the other chalybeate. See Bagnoles.

Bains. Thermal springs, in much repute among the Romans. See Bains.

Baldur, Saline thermal springs. See Baldur.

Ballycastle. Two chalybeate springs, one in which the iron is in combination with carbonic acid, the other with sulphuric acid. See Ballycastle.

Ballymoney, Downshire. A sulphureous spring, said to contain iron.

Bagnères, France. Thermal springs, in much repute as baths. See Bagnères.

Ballyfin, North America. A highly acidulous chalybeate spring. According to the recent analysis of a French chemist, 25 fluid ounces contain of

Carbonic
WATER.

Carbonic acid - - - 75
Muriate of soda - - - 31
Carbonate of lime - - - 22
Muriate of magnesia - - - 12.5
Muriate of lime - - - 5
Carbonate of iron - - - 4

74.5

Barge. Sulphureous thermal springs, in considerable repute. See BARGE.

Barnet, Hertfordshire. A weak saline spring. At Northhall, about three miles from Barnet, is another of the same description, but a little stronger.

Bath. Celebrated saline thermal springs, containing like-wise a little iron. (See BATH.) One of the most recent and probably correct analyses of these waters is by Mr. Phillips. According to this gentleman, a wine pint contains of

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<tr>
<td>Carbonic acid</td>
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<tr>
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<td>9</td>
</tr>
<tr>
<td>Muriate of soda</td>
<td>3.3</td>
</tr>
<tr>
<td>Sulphate of soda</td>
<td>1.5</td>
</tr>
<tr>
<td>Carbonate of lime</td>
<td>0.8</td>
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<tr>
<td>Silice</td>
<td>0.2</td>
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<tr>
<td>Oxyd of iron</td>
<td>0.0947</td>
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Bilton, Yorkshire. A weak saline sulphureous spring.

Birkenhead, Warwickshire. A saline chalybeate spring.

Borrowdale, Cumberland. A strong saline water. See BORROWDALE.

Borset. Sulphurous thermal springs, in considerable repute. See BORSET.

Brabach, Germany. An acidulous chalybeate spring.

Brandolos, Italy. A weak acidulous chalybeate spring.

Brentwood, Essex. A saline spring.

Bredington, Oxfordshire. A saline chalybeate spring: sulphate of iron. (See BRIGHTHELMSTON.) According to Dr. R. March's analysis, a wine pint contains of

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<td>4.09</td>
</tr>
<tr>
<td>Muriate of soda</td>
<td>1.53</td>
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<tr>
<td>Muriate of magnesia</td>
<td>0.75</td>
</tr>
<tr>
<td>Silice</td>
<td>0.14</td>
</tr>
<tr>
<td>Lofes</td>
<td>0.19</td>
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8.50

Bristol Hotwell. A simple thermal water. As this spring has not been described in its proper place, we shall infer the following short account of it here. This water is inodorous, perfectly limpid and sparkling, and sends forth air-bubbles when poured into a glass. It is agreeable to the palate, but has no decided taste. Its specific gravity is rated to be 1.00077. Its temperature, upon an average, is about 74°. A wine pint, according to Dr. Carrick's analysis, contains of

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<th></th>
<th>Cub. Inches.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbonic acid gas</td>
<td>3.75</td>
</tr>
<tr>
<td>Common air</td>
<td>0.375</td>
</tr>
</tbody>
</table>

4.125

3.9

It was formerly much celebrated in consumption, but its supposed good effects in this disease have been justly called in question by modern writers.

Bromley, Kent. A chalybeate spring. See BROMLEY.

Broughton, Yorkshire. A strong saline sulphureous spring, similar to that of Harrowgate.

Buck, near Carlbad, in Bohemia. A weak acidulous water.

Buglaveen, Cheffry. A saline sulphureous water.

Burlington, or Bridlington, Yorkshire. A chalybeate water slightly saline.

Burnley, Lancashire. A chalybeate water slightly saline.

Buxton. A simple thermal water. See BUXTON-Water.

Cannock, Staffordshire. A chalybeate water.

Cargy, near Chester. A weak saline water.

Carlebad. Celebrated acidulo-chalybeate thermal springs.

See CARLEBAD.

Carlton, Nottingham. A chalybeate water.

Castletown. A chalybeate water. See CASTLETOWN.

Castlemain. A sulphureous spring said to contain iron.

See CASTLEMAIN.

Cawthorpe, Lincolnshire. A chalybeate spring slightly saline.

Chedlington, Oxfordshire. A sulphureous water slightly saline.

Chalons-Fontaine, near Liege, Germany. Thermal springs celebrated as baths.

*Cheltenham. Saline and saline chalybeate springs. See CHELTONHAM.

Chippenham, Wiltshire. A chalybeate spring.

Clithers. An acidulous chalybeate spring. See CLEITHERS.

Cleves, Oxfordshire. A saline spring.

Cobham, Surry. A chalybeate water.

Codfol Wood, Staffordshire. A sulphureous spring.

Colchester, Essex. A saline spring.

Cullegendon, Cornwall. A chalybeate spring.

Cumber, or Cumber, Berkshire. A weak saline spring.

Corkphkine, near Edinburgh. A weak sulphureous spring slightly saline.

Coventry. A saline chalybeate spring. See COVENTRY.

Cricklewood, London. A strong saline sulphureous water.

Crofts, Yorkshire. A sulphureous water slightly saline.

Crofts, Waterford. A sulphureous spring.

Cunlly-bayle, Lancashire. A strong sulphureous spring slightly saline.

Doddington. Saline sulphureous springs. See DODDINGTON.

Derby. A chalybeate spring.

Derrindaff,
Derrindaff, Cavan. A sulphureous spring slightly saline.  
Derry-branch, Fermanagh. A sulphureous spring.  
Dog and Duck, St. George's Fields, Southwark. A saline spring.  
Driag-well, Cumberland. An acidulous chalybeate spring.  
Drumaframe, Leitrim. A strong sulphureous spring slightly saline.  
Dublin. Several weak saline springs.  
Dulwich, Kent. Pretty strong saline spring.  
Dunblane, Perthshire. These springs have been only lately discovered. They have been accurately analysed by Dr. Murray. There are two springs, both of a similar nature, that is to say, saline, with a minute proportion of iron. A wine pint of the north spring was found by Dr. M. to contain of

<table>
<thead>
<tr>
<th>Component</th>
<th>Grams</th>
<th>Muriate of soda</th>
<th>24.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbonate of lime with a trace of iron</td>
<td>0.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The same quantity of the south spring yielded

<table>
<thead>
<tr>
<th>Component</th>
<th>Grams</th>
<th>Muriate of soda</th>
<th>22.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbonate of lime with a trace of iron</td>
<td>0.3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

45.9

Dunfe, Scotland. A chalybeate spring.  
Durham. A strong sulphureous water slightly saline.  
*Egra*, Bohemia. A celebrated saline chalybeate spring.  
See *Egra*.  
*Epsom*. A celebrated saline spring. See *Epsom*.  
*Felsted, Essex*. A chalybeate spring.  
*Fiby*, Yorkshire. A saline chalybeate spring.  
*Francofort on the Maine*. Saline sulphureous springs.  
See *Francofort*.  
*Galway*, Ireland. A chalybeate spring.  
*Geyser*, Iceland. Remarkable thermal springs. See *Iceland*.  
*Glasnile*, Ireland. A saline chalybeate spring.  
*Glasgowsbury*. A chalybeate spring slightly saline. See *Glasstonbury*.  
Glendy, Angushire. A strong chalybeate spring.  
*Grantenhaw*, Downshire. A chalybeate spring.  
*Hagb*, Lancashire. A chalybeate spring: sulphate of iron.  
*Hamphstead*. A chalybeate water. See *Hamphstead*. The most recent analysis of this water is by Mr. Bills, according to whom a wine gallon contains of

<table>
<thead>
<tr>
<th>Component</th>
<th>Cub. Inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbonic acid</td>
<td>10.1</td>
</tr>
<tr>
<td>Atmospheric air</td>
<td>90.9</td>
</tr>
</tbody>
</table>

101.  
<table>
<thead>
<tr>
<th>Component</th>
<th>Grains</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxyd of iron</td>
<td>1.5</td>
</tr>
<tr>
<td>Muriate of magnesia</td>
<td>1.75</td>
</tr>
<tr>
<td>Sulphate of lime</td>
<td>2.12</td>
</tr>
<tr>
<td>Muriate of soda nearly</td>
<td>1.0</td>
</tr>
<tr>
<td>Of flex about</td>
<td>0.38</td>
</tr>
</tbody>
</table>

6.75

Hanbridge, Lancashire. A chalybeate water slightly saline.  
Hansly, Shropshire. Two springs, one saline the other chalybeate.  
*Harlowgate*. Saline sulphureous springs. See *Harlowgate*.  
Hartfell, Annandale. A chalybeate spring: sulphate of iron. According to Dr. Garnett’s analysis, a wine pint of this water contains of

<table>
<thead>
<tr>
<th>Component</th>
<th>Grains</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulphate of iron</td>
<td>10.5</td>
</tr>
<tr>
<td>Sulphate of alumina</td>
<td>1.5</td>
</tr>
<tr>
<td>Oxyd of iron</td>
<td>1.875</td>
</tr>
</tbody>
</table>

13.875

Hartlepool. A chalybeate spring. See *Hartlepool*.  
*Holm*, Wiltshire. A weak saline water.  
*Holmwood*, Leicestershire. A chalybeate spring: sulphate of iron. See *Holm Waters*.  
*Inglesby*, Lancashire. A strong chalybeate spring.  
*Isle of Wight*. A very strong chalybeate: sulphate of iron.  
*Islington*. A chalybeate spring. See *Islington*.  
*Katrine Loeb*, Scotland. On the north side of this lake is a strong chalybeate spring.  
*Keddlestone*, Derbyshire. A strong sulphureous water moderately saline.  
*Kenington*. A saline spring. See *Kensington*.  
*Kiburn*, Middlesex. A saline spring.  
*Killedare-vanwally*, Fermanagh. A chalybeate water slightly saline.  
*Killafer*, Fermanagh. A strong sulphureous water.  
*Kinliltnor*, or *Kynoln*, Nottinghamshire. A weak saline water.  
*Kincardine*. A chalybeate spring.  
*King's-cliff*, Northamptonshire. A chalybeate spring weakly saline.  
*Kirby or Kirkby-thower*, Wiltmoreland. Two chalybeate springs.  
*Knaresborough*, the *Dropping-well*, contains lime held in solution by carbonic acid. See *Knaresborough*.  
*Knowsley*, Lancashire. A chalybeate spring.  
*Korymna*, Moravia. A very strong sulphureous spring.  
*Kuka*, Bohemia. A chalybeate acidulous water.  
*Lancagere*, A chalybeate spring slightly saline.  
*Latham*, Lancashire. A chalybeate spring.  
*Leuk*, Valois, Switzerland. Thermal springs.  
*Llandrinidod*, Radnorshire. Three springs; one saline, another sulphureous, and the third chalybeate.  
*Leamington*. A saline spring. See *Warwick*.  
*Lincoln*, Bath. A chalybeate spring slightly saline.  
*Lipteak*, Fermanagh. Two sulphureous springs.  
*Lis-done-varna*, Clare. A strong chalybeate water.  
*Looebury*, Yorkshire. A sulphureous spring slightly saline.  
*Mackmeabroon*, near Cork. A chalybeate spring.  
*Maherberg*, Kerry. A saline spring.

Mallow,
WATER.

**Water**

*Malvern,* Worcestershire. Very pure springs. See *Malvern.*

One wine gallon of the Malvern Holywell waters, according to Dr. Willon, contains of

<table>
<thead>
<tr>
<th></th>
<th>Grains.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbonate of soda</td>
<td>5.33</td>
</tr>
<tr>
<td>Carbonate of lime</td>
<td>1.6</td>
</tr>
<tr>
<td>Carbonate of magnesia</td>
<td>0.919</td>
</tr>
<tr>
<td>Carbonate of iron</td>
<td>0.625</td>
</tr>
<tr>
<td>Sulphate of soda</td>
<td>2.896</td>
</tr>
<tr>
<td>Muriate of soda</td>
<td>1.553</td>
</tr>
<tr>
<td>Redudium, flex</td>
<td>1.687</td>
</tr>
</tbody>
</table>

According to the same chemist, one gallon of the Malvern St. Ann’s well contains of

<table>
<thead>
<tr>
<th></th>
<th>Grains.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbonate of soda</td>
<td>3.55</td>
</tr>
<tr>
<td>Carbonate of lime</td>
<td>1.32</td>
</tr>
<tr>
<td>Carbonate of magnesia</td>
<td>0.26</td>
</tr>
<tr>
<td>Carbonate of iron</td>
<td>0.38</td>
</tr>
<tr>
<td>Sulphate of soda</td>
<td>1.48</td>
</tr>
<tr>
<td>Muriate of soda</td>
<td>0.955</td>
</tr>
<tr>
<td>Redudium, flex</td>
<td>0.47</td>
</tr>
</tbody>
</table>

**Plombiers,** France. A thermal spring.

**Pontgibaud,** France. A weak acidulous spring.

**Pyrmont,** Welfphalia. A highly acidulous chalybeate spring. See **Pyrmont.**

**Queen’s Camel,** Somersetshire. A sulphurous spring.

**Richmond,** Surry. A calamine spring.

**Road,** Wiltshire. A chalybeate spring.

**Rougham,** Lancashire. A chalybeate spring.

**St. Bartholomew’s Well,** Cork. A chalybeate water slightly saline.

**St. Bernard’s Well,** Edinburgh. A sulphurous water slightly saline.

**St. Erasius’s Well,** Staffordshire. A weak saline water.

**St. Winifred’s Well,** Flint. A very pure spring. See **HOLYWELL.**

**Scarborough,** Yorkshire. A saline chalybeate spring. See **SCARBOROUGH.**

**Schoolby’s Mountain,** United States. A weak chalybeate spring.

**Schiliensert,** Switzerland. An acidulous chalybeate spring.

**Sea-water.** See **SEA** and the former part of this article.

**Sedlitz,** A saline water. See **SEDLITZ.**

**Selzter,** An highly acidulous water. See **SELTZER.**

**Sen, or Seend,** Wiltshire. Two chalybeate springs. See **SELDON.**

**Shedwell,** A saline chalybeate spring: sulphate of iron? Shopmoor, Welford. A sulphurous spring slightly saline.

**Skelton,** Derbyshire. A sulphurous spring slightly saline.

**Shipston,** Yorkshire. A sulphurous spring moderately saline.

**Somerham,** Huntingdonshire. A chalybeate spring: sulphate of iron. See **SOMERHAM.**

**Spa,** A highly acidulous chalybeate springs. See **SPA.**

**Stanger,** Cumberland. A saline chalybeate spring.

**Stenton,** Lincolnshire. A chalybeate spring slightly saline.

**Streatham,** Surry. A saline spring. See **STREATHAM.**

**Sundborn,** Saxony. A very pure spring. See **SUNDBOROUGH.**

**Swansea,** Glamorgan. A chalybeate spring: sulphate of iron. See **SWANSEA.**

**Sydenham,** Kent. A weak saline spring.

**Tarleton,** Lancashire. A chalybeate spring slightly saline.

**Teakby,** Gloucesteshire. A saline spring.

**Theby,** Norfolke. A chalybeate spring slightly acidulous.

**Thoroton,** Nottinghamshire. A chalybeate spring slightly saline.

**Thuruh,** Yorkshire. A saline chalybeate spring.

<table>
<thead>
<tr>
<th></th>
<th>Cubic Inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atmospheric air</td>
<td>-</td>
</tr>
<tr>
<td>Carbonic acid gas</td>
<td>-</td>
</tr>
<tr>
<td>Muriate of soda</td>
<td>34.3</td>
</tr>
<tr>
<td>Muriate of lime</td>
<td>19.5</td>
</tr>
<tr>
<td>Sulphate of lime</td>
<td>9.0</td>
</tr>
<tr>
<td>Carbonate of lime</td>
<td>5.0</td>
</tr>
</tbody>
</table>

**Trithillet,**
Tilbelf, Derbyshire. A chalybeate spring slightly acidulous.

Tilbury, Essex. A chalky spring slightly chalybeate.

Tobermory, near Dublin. A chalky spring.

Tournai, Belgium. A chalybeate spring in considerable repute.

Tralje, Kerry. A chalybeate spring.

*Tunbridge Wells, Kent. A chalybeate spring. See Tunbridge Wells.

Uppingham, Leicestershire. A strong chalky spring, sulphureous spring. See Vichy.

Vallens, France. A weak acidulous spring slightly chalky.

Vichy, France. A highly acidulous-chalybeate thermal spring. See Vichy.

Warkworth, Northumberland. A chalky spring. See Vichy.

Wells, Somerset. A well-chalky spring. See Vichy.

Wells, Dorset. A chalky spring: sulphate of iron.

Wexford, Ireland. A weak chalybeate spring.

White Acres, Lancashire. A chalky spring.

Wigan, Lancashire. A chalybeate spring.

Wiggleworth, Yorkshire. A sulphureous spring slightly chalky.

Wildungen, Germany. A weak acidulous water.

Whitby, Esk. A chalybeate spring.

Wirksworth, Derbyshire. A chalky spring. See Zaborovice.

Zaborovice, Germany. A weak chalky acidulous water.

*Zealand, New Zealand. An acidulous water: muriatic acid.

See the article Aque, where many thermal and other springs are noticed, which have been omitted in the above catalogue.

Among the older writers on mineral waters, see Rutty, Monro, Elliot, and others. One of the best modern treatises on mineral waters is doubtless that of Dr. Saunders, to which we have been particularly indebted. Detached essays on particular waters are too numerous to be all noticed. Among the more recent publications in this country may be enumerated those of Phillips on the Bath waters; Scudamore on the Tunbridge Wells water; Jones on the Spa waters; and Brande on the Cheltenham waters.

The chief of the older writers on the analysis of mineral waters, are Bergman and Kirwan. Latterly, some very valuable essays have been published on this subject by Dr. Murray of Edinburgh, of which we have availed ourselves in the above article.

WATER of crystallization, in Chemistry, is a denomination applied to the water attracted by many chalky bodies during the act of crystallization. Some salts contain no water of crystallization, while others contain a very large proportion. Water always appears to enter into the composition of crystals in a definite proportion. Water can be commonly separated from salts without affecting their chalky properties, and may be restored to them by dissolving them in water, and suffering them to crystallize. See CRISTALLIZATION AND SALTS.

WATER, Distilled or Simple, in Medicine and Pharmacy, consist chiefly of simple water slightly impregnated with the essential oils of different plants, and are principally used as vehicles for more active remedies. They were formerly very numerous, but their numbers have been very properly much reduced by the moderns. See AQUE DISTILLATE, where all those in common use are enumerated.

WATER, Spirituous, Cordial, or Compound, in Pharmacy, &c., was the name formerly given to what are now denominated spirits, the menstrua being alcohol, and the impregnating ingredients commonly various. See AQUE Cardiacae, and SPIRIT. For the methods of preparing such compounds, see also DISTILLATION, and OIL, ESSENTIAL.

WATER, in Agriculture and Rural Economy, is a fluid of great utility for many different purposes. The nature of the composition of water, and the great power and capacity which it possesses for taking up and holding a variety of different matters in the state of diffusion or solution, as well as the circumstance of its being everywhere present amongst all kinds of bodies, renders it particularly useful in the growth of plants as crops, and in many other ways.

Dr. Woodward, indeed, from finding it to contain the particles of most sorts of extraneous substances, was led to suppose that some of them were the proper matter of nutrition; as water is constantly found to afford so much the less nourishment, the more it is purified by distillation, or other means. So that water, as such merely, did not appear to be the proper nutriment of vegetables, but only the medium or vehicle that contains the nutritious particles or properties, and which conveys them along with it through all the parts of the plant. The more full and complete knowledge of the nature and properties of water which has since been acquired, have, however, led the matter in a more clear and satisfactory point of view. See the article WATER.

Water is seldom, if ever, met with in a state of perfect purity, nor often in that even which is sufficiently so for the different operations and uses to which it may be necessary to apply it. Now have all the trials that have ever been made been yet capable of producing it perhaps perfectly pure. There seems indeed to be no fort of standard by which the weight and purity of water can be readily and easily ascertained. It is, in fact, a very difficult matter, however useful and advantageous it might be in many different intentions, as water fearfully ever continues for any length of time exactly of the same weight, or perhaps purity; as by reason of the air and calorice, or matter of heat contained in it, much variation in respect to the former continually takes place. The effects which different degrees of heat have on the gravity of water are well shewn by the expansion of it in boiling. It is this which makes the chief difficulty in fixing the specific gravity of water, in the view of settling its degree of purity. The purest water that is capable of being obtained is, however, thought by some, as Mr. Hawkbee, who has made many experiments on the subject, to be eight hundred and fifty times heavier than air. But others, whose trials have not been less numerous or correct, have made it not more than about eight hundred, or eight hundred and thirty-six times heavier than air. From whence this general proportion may perhaps be deduced, which may be considered as a fort of standard in the bunefens, that when the barometer is at 300, and the thermometer at 550, then water is eight hundred and twenty times heavier than air; and that in such a place the cubic foot of water weighs one thousand ounces without disposing, and that of air 1,224, or 4,567.2 nearly. (See WATER.) There is not, however, any very exact standard in air, as the more water there is contained in the air, the heavier it must of course be; for indeed a considerable part of the weight of the atmosphere appears to arise from the water that is contained in it. Consequentially, the nearer any water is found to approach the above standard, the purer it may be concluded to be; which may serve to guide and direct many practical uses and applications of the fluid.

In regard to the properties and effects of water, it is well known to be extremely volatile and expansive, being capable of reduction wholly into the state of vapour, and of being dissipated when exposed to heat and confined. In this
WATER.

this flate, when properly confined, it is of great use and applica-
tion for a variety of purposes. See Steam.

It is found, however, that water, when heated in an open
vessel, acquires no more than a certain determinate propor-
tion or degree of heat, whatsoever may be the intensity or
the length of continuance of the fire to which it is exposed;
which greatest proportion or degree of it is when it boils in
the completest manner. The degree of heat, however, which
is necessary to make water boil perfectly, is va-
riable, according as the purity of the water, and the weight
of the atmosphere, may happen to be. A knowledge of this
may be of considerable utility and benefit in the application
of heat to this fluid, in a number of operations, as tending
to raise time, trouble, and the consumption of fuel.

The ready penetrability and separability of water from
the bodies with which it may have united, as well as its pro-
PERTIES and powers of cohesion, solution, and coagulation,
rather, render it still more extensively applicable and useful on
many occasions.

Water is a fluid which, in popular language, is dis-
tinguished into many different kinds, according to the quali-
ties of it, and the circumstances under which it makes
its appearance, or is found (see the preceding article Water)
; as fresh water, or that which is per-
fected infuipid, without any saline or other taste, and in-
dorous, being that which is the natural and pure flate of
water; in this flate, it is well fitted for most forts of domes-
tic as well as many other uses: hard water, or that in which
soap does not completely or uniformly diffuse and diffuse
itself, but appears in a fotype of curdled or coagulated flate:
its certain from this that the diffloping power of hard water
is less than that of soft; and that hence it is less fit for
washing, bleaching, dyeing, boiling culinary vegetables, wa-
tering plants and trees, and many other purposes. It is,
for the most part, found, that the hardness of water pro-
ceeds either from saline matters, or from the presence of
gas. The hardnees which arises from saline matters may
mostiy be discovered and removed by the addition of small
quantities, as a few drops, of a solution of fixed alkali:
and that which is caused by the latter by-boiling, or ex-
posure to the open air for some length of time. That
the waters of springs are hard; but those of rivers soft.
That hard waters are remarkably indifposed to corrupt;
they even prefer putrefactive substances for a considerabile
length of time ; hence they would seem to be best fitted for keep-
ing, especially as they are so easily capable of being softened
by a very little of the alkaline solution being added to
them. Putrid water is that which has acquired an offensive
smell and taste by the putrefaction of the animal or vegeta-
table substances which are contained in it. This fort of water
is of a very pernicious quality, and quite unfit for any pur-
pose. Caufic lime, when put into water, is useful in pref-
serving it longer in a sweet flate ; and even exposure to the
air in broad shallow vessels has the fame effect. And water
in this putrid flate may be, in a great measure, rendered
sweet by having a current of fresh air paffed through it, from
the bottom to the top. Water in this condition is, of course,
always to be avoided, except for the purpose of manure,
for which, in some cafes, it is of great use. Rain-water,
or that which may be considered as a pure fort of distilled
water, but as impregnated during its paffage through the
air with a considerable quantity of putrefactive matter,
whence, in some measure, its great superiority to any
other in fertilizing the earth or soil, as well as in promoting
the growth of trees and plants. Whence too its inferiority
for some domestic purposes to that of the spring or river
kind, even where it can be readily and well procured; but,
more especially, such as is collected and gotten from fpouts,
trunks, and other contrivances put below the roofs of
houses and other buildings, which are the usual modes of
procuring it in this country, which is obviously very impure,
and in a short time becomes in the putrid flate. From its soft-
ness, it, however, answers well in some uses, after it has
become pretty pure by standing. River-water, or that
which is next in purity to that of snow, or the distilled
kind, and which, for most domestic and some other uses, is supe-
rrior to either of them, as having less putrefactive matter,
and more fixed air, or carbonic acid gas in it. Of this water,
that, however, which runs over a clean, rocky, or gravelly,
bottom, is by much the purest. River-waters, in
general, are found to putrefy sooner than those of springs;
and that during their putrefaction they throw off a part of
the extraneous matter they contain, and at length become
sweet again, and purer than in their first flate; after which
they will commonly preserve sweet a great length of time;
this is particularly the case with some river-water, as that of
the Thames. It is this fort of water that is so extensively use-
ful in improving grnfs-lands, when thrown over them in a pro-
per manner. See Watering Land, and Water Meadow.

There are some other forts of water, as salt water, or that
which contains large portions of salt in it, so as to be feili-
ble to the taste. This is of most use in the preparation of
that substance from it, but may perhaps be applicable in
some other ways. Sea-water, or that which is a fort of an
amelioration of bodies or substances, in which this fluid may
be said to have barely the principal part: it is, in short,
an universal collection of most of the matters in nature,
sustained and kept swimming in this fluid as a medium or vehicle:
being a diffuse solutum of varius substances, as common salt,
bitter cathartick salt, different other saline matters, and a
compound of muriacic acid with magnesia, mixed and blended
together in a variety of proportions. It is capable of being
freensened by simple distillation, without any addition ;
and is about three parts in a hundred heavier than common
water; the temperature of it at great depths being from
thirty to forty degrees; but near the surface it follows the
temperature of the air more nearly. It is probable, from
some trials lately made with it, that it may be useful when
applied to land in some cafes. Its greater weight and other
properties would seem to be favourable for this in some in-
tentions. It is the muddy material conveyed in the flate of
diffusion in this water, which is found so beneficial in the
warping of land in some cafes and situations. (See War-
ring of Land.) Snow-water, or that which is the purer of
all the common waters, when the snow has been collected
in its pure flate, and kept in a dry place, in clean glass
vessels, not clofly stopped, but covered from dust and other
such matters; this water becomes in time putrid, although
in well-stopperd bottles it will continue unaltered for several
years; but distilled water undergoes no alteration in either
circumstance. Snow-water will be seen below to be useful
in promoting the nutrition of plants. Spring-water, or that
which is commonly impregnated with some forts of mate-
rials or other, as a small portion of imperfect neutral salt
extracted and taken up from the different strata through
which it paffes and percolates; great quantities of stony
matter, which are deposited as it runs along, and large
masses of stone thus formed, sometimes too incruling dif-
ferent substances of the animal and vegetable kinds, which
it is said to petrify. Spring-water is much used for domes-
tic purposes in many cafes, and on account of its coolness
and cleaneenes forms a suitable drink for man and animals;
but from its being usually somewhat hard, is inferior in
some intentions to that which has run a considerable distance
in an open channel, exposed to the action and influence of the air.

The water of springs arises and is caused by rain, and from mills and moisture in the atmosphere; which falling upon the hills and higher grounds, as well as other parts, soak in and sink down into the earth, passing along between the different strata, until they find a vent or outlet in the form of a spring. See Draining of Land, Spring, and Wall. Also, Spring-Draining.

It is only under certain circumstances that spring-water can be applied over the surface of grass-land with much benefit; as where it is considerably impregnated and loaded with particular sorts of materials, as those of the calcareous, and perhaps some other kinds.

A late philosophical writer has remarked, that the necessity of much water in the progress of the growth of plants or their vegetation, is shown by the great quantity which excretes naturally in all parts of them; insomuch that many roots, as those of the squill and rhubarb, are known to lose about six parts out of seven of their original weight, simply by drying them before the fire; which quantity of moisture notwithstanding does not exhale in the common heat of the atmosphere during the life of the root; as may be seen in the growth of squills in the shop of the druggist, and of onions on the floors of the store-rooms of the feedman. And that a second necessity of much water in the economy of their vegetation or growth may be deduced from the great pervaporation of them, which appears from the experiments of Hales and others, who, like Sanderson, have, it is said, estimated the quantity of pervaporation from their daily loss of weight; which, however, is it is supposed, is not an accurate conclusion, either in respect to plants or animals, as they both absorb moisture from the atmosphere, as well as perfpire it. But that this great pervaporation of vegetables, like that from the skin and lungs of animals, does not appear to consist of excrementitious matter, because it has in general no putrefactive smell or taste, but seems to be secreted first for the purpose of keeping the external surface of the leaves from becoming dry, which would prevent the oxygen of the atmosphere from entering into the vegetable blood or juice through them; since, according to the experiments of Dr. Priestley on animal membranes, the oxygen will only pass through them when they are moist. A second use of this great pervaporation is, it is said, to keep the bark supple by its moisture, and thus to prevent its being cracked by the motion of the branches in the wind. And though a great part of this pervaporative matter is probably absorbed, as on the skins of animals, yet as it exerts on so large a surface of leaves and twigs, much of it must necessarily evaporate on dry and windy days.

And the discovery of the decomposition of water has, it is said, led to a third great use of water in the vegetable economy, which is probably owing to its ready decomposition by their organs of digestion, fangulization, or juice-forming, and secretion. This is evinced, it is thought, first, by the great quantity of hydrogen which excretes in the composition of many of their inflammable parts; and secondly, from the curious circumstance which was first discovered by the ingenious Dr. Priestley, that the water which they perspire is hyper-oxygenated, and in consequence always ready to part with its superabundance of oxygen, when exposed to the sun's light; whence it may be concluded, it is thought, that a part of the hydrogen, which was previously an ingredient of this water, has been separated from it, and used in the vegetable economy. And that, from the decomposition of water, when confined in contact with air beneath the soil, the nitrous acid seems to be produced, and ammonia, both of which are believed to be useful to vegetation and the growth of plants.

But that, beside these peculiar uses of a great quantity of water, the more common uses of it both to vegetable and animal life, along with caloric or the matter of heat, are to produce or preserve a due suppliance of humidity of the foliis, and a due degree of fluidity of liquids which they contain or circulate; and, lastly, for the purpose of diffusing or diffusing in it other solid or fluid substances, and thus rendering them capable of absorption, circulation, and secretion.

It is beneficial, too, in the view of promoting the fertility of grass-lands, by the occasional suffusion or flowing over them, by which it not only supplies simple moisture for the purposes above noticed in the drier parts of the season, but brings along with it calcareous earth and azotic air from the neighbouring springs in many instances, or other manures from the rivers and brooks. Still another beneficial consequence of it is to give a due penetrability to the soil or mould, which otherwise, in most situations, becomes stiff and hard, as to stop the elongation and dilution of the tender roots of plants; but notwithstanding, the cohesion of the soil or earthy particles may be too much or too greatly diminished or leached, by great and perpetual moisture, so as not to give sufficient firmness to the roots of trees or plants. It may also be injurious in some cases, as in very hayly showers, by washing off and taking away much of the decomposing animal and vegetable remnants, which are soluble or diffusible in it, and carrying them down the rivers and brooks into the sea; and from the sides of hills, injury in this way is produced by small showers; and the evaporation of water or moisture from the surface of the earth may produce so much cold as to injure such terrestrial plants as are too long covered with it.

The author of the "Elements of Agricultural Chemistry" has concluded, that water is absolutely necessary to the economy of vegetation, both in its elastic and fluid state; and that it is not devoid of use, even in its solid form. Snow and ice are, it is said, bad conductors of heat; and that, consequently, when the ground is covered with snow, or the surface of the soil or of water is frozen, the roots or bulbs of the plants beneath are protected by the congealed water from the influence of the atmosphere, the temperature of which, in northern winters, is usually very much below the freezing-point; and this water becomes the first nourishment of the plants in early spring. The expansion of water too during its congelation, at which time its volume increases one-twelfth, and its contraction of bulk during a thaw, tend, it is observed, to pulverize the soil, to separate the parts of it from each other, and to make it more permeable to the influence of the air, and the fibres of the roots of vegetables.

Water also, as constituting the daily necessary drink of the different sorts of domestic animals which form the live-flock of the farmer, is always to be particularly attended to, and to be provided as fully and of as good quality as can possibly be met with; as such flesh constantly do belt where they have plenty of water. See Pond, and Live-Stock.

Application of water, whether of ponds, brooks, rivers, or other kinds, to the purpose of fisheries, is likewise a matter of great individual utility and benefit, as well as general national advantage. It is the means of increasing a most useful sort of food in almost an unlimited manner, at very little cost or expense. It provides much profitable labour and employment to some of the working classes of society; and from the trifling charge incurred in providing it, and
and the readiness of its disposal, must be a source of great wealth to the country. It should, of course, be encouraged as much as possible, wherever it can be done with convenience and success, in all parts of the kingdom. See Fishponds, Pond-Fisheries, and Salmon-Fisheries.

WATER. \[ \text{WATER, \emph{Axtent of, in Hydraulics. See Ascent and Capillary Tubes.} \]

\text{WATER, \emph{High and Low. See Flux, High, and Tide.}}

\text{WATER, \emph{Motion of.} The theory of the motion of running water is one of the principal objects of hydraulics, and many eminent mathematicians have applied themselves to this subject. But it were to be wished that their theories were more confirmed with each other, and with experience. The curious may consult \textit{for Isaac Newton's Principles, lib. ii. prop. 36. with the comment. Dan. Bernouilli's Hydrodynamics. Jo. Bernouilli, Hydraulica, Oper. tom. iv. p. 389, eq. Dr. Jurin, in the Phil. Trans. No. 352, and in Dr. Matrion's Abridg. vol. viii, p. 282, eq. S'Graveandie, Physic. Elem. Mathemat. lib. iii. par. ii. Polenus, de Caffellis, and others.}

Mr. Macquarrie, in his Fluxions, art. 537, eq., has illustrated \textit{for Isaac Newton's doctrine on this intricate subject}, which still, notwithstanding the labours of all these eminent authors, remains in a great measure obscure and uncertain.

Even the simple case of the motion of running water, which is when it issues from a hole in the bottom of a vessel kept constantly full, has never yet been determined, so as to give universal satisfaction to the learned. We shall here mention some of the phenomena of this motion, as stated by Dr. Jurin from Polen; referring for other observations on this subject to Fluids, and \emph{Hydraulic Laws of Fluids.}

1. The depth of the water in the vessel, and the time of flowing out being given, the measure of the effluent water is nearly in proportion to the hole.

2. The depth of the water, and the hole being given, the measure of the effluent water is in proportion to the time.

3. The time of flowing out, and the hole being given, the measure of the effluent water is nearly in a subduplicate proportion to the height of the water.

4. The measure of the effluent water is nearly in a ratio compounded of the proportion of the hole, the proportion of the time, and a subduplicate proportion of the depth of the water.

5. The measure of the water flowing out in a given time, is much less than that which is commonly affixed by mathematical theorems. For the velocity of effluent water is commonly supposed to be that which a heavy body would acquire \emph{in vacuo} in falling from the whole height of the water above the hole; and this being supposed, if we call the area of the hole \( F \), the height of the water above the hole \( A \), the velocity which a heavy body acquires in falling \emph{in vacuo} from that height \( V \), and the time of falling \( T \); and if the water flows out with this constant velocity \( V \), in the time \( T \), then the length of the column of water, which flows out in that time, will be \( 2 A \), and the measure of it will be \( 2 A F \). But if we calculate from Polen's accurate experiments, we shall find the quantity of water which flows out in that time to be no more than about \( 2 \frac{1}{2} \) of this measure \( 2 A F \).

Polen also found, that the quantity of water flowing out of a vessel through a cylindrical tube far exceeded that which flowed through a circular hole made in a thin lamina, the tube and hole being of equal diameter, and the height of the water both being also equal; and he found it to be so when the tube was inserted, not into the bottom, which others had observed before, but into the side of the vessel.

6. Since the measure of the water running out in the time \( T \), is \( 2 A \times \frac{1}{2} \), the length of the column of water, which runs out in that time, is \( 2 A \times \frac{1}{2} \). Therefore if each of the particles of water, which are in the hole in the same space of time, posses with equal velocity, it is plain that the common velocity of the water is such that which the space \( 2 A \times \frac{1}{2} \) would be gone over in the time \( T \), or the velocity \( \frac{V}{2} \). But this is the velocity with which water could spring \emph{in vacuo} to near \( \frac{1}{4} \)d of the height of the water above the hole.

7. But when the motion of water is turned upwards, as in fountains, these are seen to rise almost to the entire height of the water in the cistern. Therefore the water, or at least some portion of the water, sputts from the hole with almost the whole velocity \( V \), and certainly with a much greater velocity than \( V \). But this is the velocity with which water could spring \emph{in vacuo} to near \( \frac{1}{4} \)d of the height of the water above the hole.

8. Hence it is evident, that the particles of water, which are in the hole in the same point of time, do not all burst out with the same velocity, or have no common velocity; though some mathematicians have hitherto taken the contrary to be certain.

9. At a small distance from the hole, the diameter of the vein of water is much less than that of the hole. For instance, if the diameter of the hole be \( r \), the diameter of the vein of water will be \( \frac{r}{2} \) or \( \frac{r}{2} \), according to \textit{for Isaac Newton's measurement, who first observed this phenomenon; and according to Polen's measure \( \frac{20}{26} \) or \( \frac{20}{26} \), that is, taking the mean diameter \( 0.78 \), nearly.}

As to the manner of accounting for these phenomena, we have already observed that authors are not agreed: and it would be far beyond our design to state their different theories, we must therefore refer to the originals above quoted.

Neither are authors agreed as to the force with which a vein of water, spouting from a round hole in the side of a vessel, presses upon a plane directly opposed to the motion of the vein. Most authors agree that the preasure of this vein, flowing uniformly, is equal to the weight of a cylinder of water, the basis of which is the hole through which the water flows, and the height of which is equal to the height of the water in the vessel above the hole. The experiments made by Mariotte, and others, seem to countenance this opinion. But Mr. Daniel Bernouilli rejects it, and estimates this preasure by the weight of a cylinder, the diameter of which is equal to the contracted vein (according to \textit{for Isaac Newton's observation above-mentioned}), and the height of which is equal to twice the height of the water above the hole, or, more accurately, to twice the altitude corresponding to the real velocity of the spouting water; and this preasure is also equal to the force of repulsion arising from the reaction of the spouting water upon the vessel. For he says that he can demonstrate, that this force of repulsion is equal to a preasure exerted by a vein of spouting water upon a plane directly opposed to its motion, if the whole vein of water strikes perpendicularly against the plane. From whence it would follow, that the preasure or force of the vein will be greater in proportion, as its contraction is less; and this contraction vanishing, as it does when the water spouts through a short tube, and the vein being at the same time supposed to have the whole velocity it can acquire by theory, the spouting water will then exert a preasure double to what is commonly suppos'd. But the actual velocity of the water being always something less than it ought to be by theory, and the vein of water being not uncommonly contracted to almost one half, experiments
WATER.

The ingenious author remarks that he speaks only of single veins of water, the whole of which are received by the planes upon which they press; for as to the preffures exerted by fluids surrounding the bodies they press upon, as the wind, or a river, the case is different, though conformed with the former by writers on this subject. Hydrodynamica, fect. 13. p. 289.

M. Bernouilli endeavours to confirm his theory by a differentiation in the eighth volume of the Acta Petropolitana; where he observes, that the experiments formerly made before the Academy of Sciences at Paris, to establish the quantity of the preffure exerted by a vein of fpouting water, are very far from proving the truth of the rule they are brought to establish. For instance, in one of thefe experiments, the height of the water in the vefsel above the hole from whence the vein fpouted was two feet Paris meafure; the diameter of the circular hole, which was cut in the horizontal bottom of the vefsel, was four lines; and the force of the vein of water was observed to be one ounce and three-quarters. But the weight of a cylinder of water of the diameter of the hole, and of the height of the water in the vefsel, is fcarce equal to one ounce and three-eighths. The difference, therefore, is at least three-eighths of an ounce, which is about three-elevenths of the whole weight of the before-mentioned cylinder of water. So that it is furnifhing, that this difference should have been ascribed to the removal of the plane, receiving the impulfe, to fome distance from the hole; for this caufe, fupposing the plane removed to the distance of two inches, could not produce an increase of one-fifteenth of an ounce. It appears, therefore, that the common opinion is rather overturned than confirmed by experience. Du-Hamel, Hist. Acad. Paris, ann. 1679, fect. 3. cap. 5.

M. Bernouilli, on the other hand, thinks his own theory sufficiently established by the experiments he relates; for the particulars of which, we refer to the Acta Petropolitana, vol. cit. p. 122, seq.

This ingenious author thinks that his theory of the quantity of the force of repulfion, exerted by a vein of fputing water, might be usefully applied to move fhips by pumping; and he thinks the motion produced by this repulfive force would fall little, if at all, short of that produced by rowing. He has given his reafons and computations at length in his Hydrodynamica, p. 293 to 302.

The fience of the preffures exerted by water, or other fluids in motion, is what M. Bernouilli calls hydraulic-flataica. This fience differs from hydroflatics, which confiders only the preffure of water and other fluids at reft; but hydraulic-flaticus confiders the preffure of water in motion. Thus the preffure exerted by water, moving through pipes, upon the fides of thofe pipes, is an hydraulic-flaticus conflation, and has been erroneously determined by many, who have given no other rules in thofe cafes, but fuch as are applicable only to the preffure of fluids at reft. See Hydrodynam. fect. 12. p. 256. seq.

Water, Raising of. Machines for this purpofe are fo numerous, that a minute description of fuch hydraulic machines as are in common ufe would fill a volume; and a scientific account of their principles, with the maxims necessary to be observed in their construction, would form a very complete body of mechanical fience; this is far beyond the limits of an article like the prefent, in which we can only introduce the moft striking machines which have not already been explained in different articles of this work; and for others, we muft refer to the original works in which they are defcribed.

The moft complete collection of hydraulic machines is that of Jacob Leopold, entitled "Theatrum Machinarum Hydrauliarum," published at Leipzic, in 1724 and 1725, in 2 vols. folio; these form part of his voluminous "Theatrum Machinarum," which may be confidered as containing all that was known in mechanics at that period.

M. Belidor, in his "Architectura Hydraulique," 1737, has defcribed many machines which were invented since the date of Leopold's work. This eminent engineer was a good mathematician, and his work may be confidered as a standard for the theory of the hydraulic machines of which it treats. The "Experimenter Philofophy" of Defaguillus contains fome chapters on hydraulic machinery, in which he generally follows Belidor very closely, but has translated the mathematical investigations of the former into the ordinary proccfes of arithmetic, to adapt them to the comprehension of mechanics; and in this point of view, the works of Defaguillus have been of great use. On the other hand, M. Prony published a modern edition of Belidor's work in 1792, in which, in moft cafes, he has transcribed the proccfes of the original into the modern modes of analysis; but on the whole, he has added little to our real knowledge, except his defcriptions and superb plates of Mr. Watt's steam-engine.

We do not recollect any complete collection of machines for rafing water since Belidor, although the inventions of the laft century are both numerous and important. Much information relative to them may be derived from Gregory's "Mechanics," in 2 vols. 8vo.; Dr. Robifon's Works, and his excellent articles Hydrodynamics, Pump, and Waterworks, in the Encyclopaedia Britannica; and from various miscellaneous publications, fuch as the Repertory of Arts, and the Trafactions of different learned Societies; also the collection of Mr. Smeean's Reports, in 3 vols. 4to. It is much to be regretted, that this excellent engineer never completed a defign which he formed, to publifh a complete collection of pratical hydraulic machines founded on his own experience. Among his manuscript papers which have been lent to us by Mr. Joseph Banks, we find an outline for this work, of which we have awaked ourfelves in this article.

In confidering machines for rafing water, they may be clasfified under two heads:

First, thofe machines which actuate fome kind of bucket or vefsel adapted to contain water, which vefsel is rafed up when full of water, and difcharges its contents into an elevated refervoir, then fefcends empty in order to repeat its action: of this species are, the buckets for wells, fcoops, Persian and Chinese wheels, chaplets or chains of buckets, the Noira, and the fcrew of Archaedses. It is evident from the nature of all this clasf, that they are incapable of rafing water to a greater height than that to which the machine is elevated, or provided with the means of drawing up the buckets or other vefsels; and further, that they cannot rafe conflant streams of water, but that the water must be given out by a fucceffion of difcharges from the different buckets or vefsels.

The second clasf comprises thofe machines which act by means of valves and pilions moving in cylinders, or other equivalent contrivances, and force the water to ascend through pipes or tubes; thofe machines have the advantage of rafing the water to very great heights above the place where the machine is placed. The greater part of these machines we have already defcribed under the article Pump.
and there remain but few to be considered in the present article; viz. the varieties of the hydraulic ram, of the Cheimatz fountain, and of the syphon machines.

The most obvious means of raising water is by the operation called baling, that is, lifting up water in a bucket, or other vessel, by the force of a man's arm. This method is extremely fatiguing, and is only adapted to very small elevations, such as clearing the water from a boat, &c. The most ancient hydraulic machine acts on this principle, such as the scoop and troughs, the Fen wheel, Perisan wheel, the Noira, &c.: it is, therefore, with these machines we shall commence.

The Dutch water-scoop, or shovel, is the best means of baling out water. The scoop is a kind of box, made of five pieces of board, with one end and one side open: this box is fixed at the extremity of a long pole, which the workman holds in his hand, and the weight of the scoop is borne by a cord tied to the pole near to the box, and suspended from a tripod, formed of three poles tied together at the top. The man works the machine by swinging the scoop backwards and forwards in the direction of the length of the pole; in moving the box forwards, he depresses the end of the pole, which causes the box to dip into the water, and take up a quantity which it will throw forwards and rather upwards to a considerable distance. In bringing the scoop back for another stroke, he depresses the end of the pole which he holds in his hand, and thus keeps the box out of the water. Of course this method is only applicable where the height to which the water is to be raised, or rather thrown, is very small. M. Belidor informs us, that a workman can only remove half a cubic foot in two vibrations, which he will perform in four seconds; this is at the rate of 7½ cubic feet per minute, or 450 cubic feet per hour: it is rarely applicable, except to throw the water over a bank which forms the boundary of a ditch, or other place of small depth, which is to be emptied.

The living gun, which is used in fort works from its simplicity, comes next. It is a trough of five or six feet in length, made small at one end like a spout, and gradually increasing to the opposite end, where it is about a foot or eighteen inches square. The small end is supported on pivots upon the bank over which the water is to be raised, and a lever is applied to it for a man to work it by. The large end of the trough will dip into the water, when it descends and becomes filled; but when lifted the level above the horizontal position, the contained water will run along the trough, and be delivered over the bank through the spout. This machine is much improved by making it double, or with two troughs, on the opposite sides of the centre; thus when one ascends, the other will descend so as to raise up a constant stream, which it must, in this case, deliver at a spout sideways, near to the pivot or centre on which it plays. This double machine will raise a copious stream of water, but is confined to small heights of three or four feet. If the large end of the trough has a valve opening into it to admit the water, it will fill itself more readily. A machine which operates on the same principle as this, is called the scoop-wheel, or tympanum, which is in fact several double laving machines arranged round the centre like a wheel. The advantage of this wheel is, that it always moves in the same direction, whereas the simple machine requires a reciprocating motion.

The tympanum, or scoop-wheel, mentioned by Vitruvius, is a great hollow wheel formed by a kind of barrel or drum (as its name imports): it is composed of several planks joined together, well caulked and pitched, and having a horizontal axle with pivots at the ends, on which it turns. The interior capacity of this drum is divided into eight equal spaces, by as many partitions placed in the directions of the radii; each space or cell has an orifice of about six inches in width in the rim of the drum or wheel. These openings are so shaped, as to facilitate the admission of the water; moreover, there are eight hollow channels running along the axle of the wheel and contiguous to each other, each corresponding to one of the eight large cells; into these channels the water passes out of the cells just mentioned, and after running along the channels in the axis of the wheel to a convenient distance, it escapes through orifices into a revoiror placed just under the axle. Thus when the wheel is turned round, the water is elevated through a vertical height equal to the radius of the hollow wheel.

When the tympanum is used to raise water from a running stream, it is moved by means of float boards fixed on the circumference, which are impelled by the stream; but when it is employed to raise flagrant waters, there is commonly a smaller hollow wheel fixed on the shaft at the side of the tympanum, which is turned by men walking in it, as in the old walking-crank. The chief defect of this machine is, that it raises the water in the most disadvantageous situation possible, for the load of water is always towards the extremity of a radius of the wheel, and the length of the effective lever which answers to it must continually increase as the water is raised through the whole quadrant, which the water describes in passing from the bottom of the wheel to the altitude of its centre, so that the power must act in the same manner as if it were applied to a winch or crank handle, and cannot act uniformly.

The horn-wheel was contrived to remedy this defect: it is so called, because the segments which pass from the circumferences of the large flat cylinder to its centre are not straight radii, as in the former instance, but are curved spirally. The scoops, or mouths, by turns, dip into the water, and as they rise up cause the water to pass up the horn, or curved segment, until it is as high as the centre of the wheel, and then it is discharged into a trough placed under the end of the axis, which is hollow, and has its pivots fastened to a cross.

M. de la Faye has investigated the proper curves for the scoop segments of this machine in the following manner: — When we evolve the circumference of a circle by unwrapping a string from the circumference, the end of the string will describe a curve called the involute of the circle, of which all the radii are so many tangents to the circle, as is shown by the string in its different positions whilst tracing the curve, and likewise all the radii are respectively perpendicular to the several points of the curve described by the end of the string.

The greatest radius of this curve is a line equal to the periphery of the circle evolved. The truth of this statement is shown by geometers, when treating of the generation of Evolute and Involute Curves. See those articles.

Hence, having an axle, whose circumference is a little exceeds the height to which the water is proposed to be elevated, let the circumference of the axle be evolved, and it will make a curve which will be the involute of the circle, as before mentioned. Now, let a number of pipes, or trunks, be made exactly with this curvature, and then put together around the axle, in form of a wheel, so that the further extremities of these canals will successively enter the water that is to be elevated, whilst the other extremities abut upon the shaft which is turned. Then, in the course of the rotation of the wheel, the water taken in at the extremity of each canal will rise in a vertical line, which is a tangent
WATER.

Thus, rafter the shaft, because the curves of the several channels will be at right angles to this vertical line, in the points where the line intersects the curves; and this is true in whatever position the wheel may be. Thus the action of the weight continuing always beneath the extremity of the horizontal radius of the axle will oppose the same resistance, as though it acted upon the invariable arm of a lever, in the manner of a bucket of water, which is drawn up out of a well by a rope, winding on a roller, and the power required to raise the weight will be always the same.

If the radius of the wheel, of which these hollow canals serve as bent spokes, be equal to the height through which the water is to be raised, and consequently equal to the circumference of the axle, or shaft, the power will be to the load of water reciprocally as the radius of a circle to its circumference, or directly as 1 to 5 or nearly. M. de la Faye recommended the machine to be composed of four of these canals, but it has often been constructed with eight. The wheel is turned by the impulsion of the stream upon float-boards fixed on the circumference of the wheel, and the orifices of the curvilinear canals dip one after another into the water which runs into them; and as the wheel revolves, the fluid rises in the canals, until it is as high as the centre: it then runs out in a stream from the holes in the axis, and is received into the trough fixed beneath the axis; from thence it may be conveyed by pipes or troughs to the required situation.

By this construction, the weight to be raised offers always the same resistance, and that is the least possible, while the power is applied in the most advantageous manner which the circumstances will admit of. These conditions being both fulfilled at the same time, furnish the most desirable perfection in a machine. This machine raises the water by the shortest way, namely, the perpendicular or vertical line, and in this respect is preferable to Archimedes's screw, where the water is carried up a crooked and inclined path; and besides this each curved channel in this wheel empties all the water it receives in every revolution, while the screw of Archimedes delivers only a small portion of the fluid with which it is charged, being often loaded with twenty times as much water as is discharged at one rotation, and thus requiring an increase of labour when a large quantity is intended to be raised by it. The horn-wheel would be one of the most perfect machines for raising water, were not its powers confined to such altitudes as the semi-diameter of the wheel.

The flange, or fen-wheel, comes next to be described. This is a vertical wheel, made exactly like those water-wheels for turning mills which are called break-wheels, and in the same manner the wheel is surrounded at the lower quadrant by a curved sweep of masonry or break, to which the floats of the wheel are fitted with the greatest accuracy, but do not absolutely touch. This wheel, being turned round in a direction contrary to that in which a water-wheel turns, will carry water before its floats, and raise it up against the break until it runs over the same. The operation is just the reverse of the water-wheel; and the only difference in the construction of the two machines is, that the flange-wheel requires no fluet to be placed at the top of the break, because the water must be allowed to run freely away from the top of the break; but the water-wheel requires a fluet or sluice to regulate the quantity of water which shall flow to the wheel.

It is by this kind of machine that the extensive fens of Holland are drained; and in Lincoln and Cambridgeshire they are also used very extensively. They are, in general, worked by the power of the wind, and are on a very large scale.

Mr. Smeaton made a horse-machine on this plan, which raised thirty-three hogheads per minute, to the height of four feet and a half, when it was worked by four horses; but a sluice was placed in the channel which admitted the water to the wheel, so as to supply the water in a greater or lesser quantity; and by this means, the same machine could be adapted to the power of three or two horses. The crown or top of the break, over which the water was delivered, was not elevated to the full height to which the water was to be raised, but it was laid twelve inches beneath the surface, and the body of water which the wheel raised up was sufficient to drive this depth of water before it; but to prevent the return of the water when the mill ceased working, two pointed doors were placed in the channel leading from the wheel, like the gates of a canal-lock; these doors opened freely, to let the water pass, but would shut and stop the water from returning. The proportions of this machine were as follows:

Diameter of the track in which the horses walked
Great cog-wheel fixed on the per-
Trundle worked by the wheel
Diameter of the water-wheel on the
Breath of the wheel
Number of its floats

The floats did not point to the centre of the wheel, but formed tangents to a radius, equal to about half the radius of the wheel. The floats of the wheel were very exactly fitted to the channel or pit in which it worked, so as not to touch.

The bucket-wheel is a very ancient method of raising water; but it cannot lift water to a greater height than its own diameter. The last machine was the reverse of the break water-wheel, and the present is the reverse of the over-shot water-wheel, for the circumference of the wheel is surrounded by buckets, which dip in the water beneath the wheel, and take up water, which they discharge at the top of the wheel into an elevated trough or reservoir. The wheel is mounted upon an horizontal axis, and turns upon pivots; it is put in motion by the force of a current of water striking the float-boards fixed on the circumference of the wheel; or if there is no current in the water, it may be moved by making the wheel hollow within for a man to walk in it, as is common in some kinds of cranes, or the wheel may be turned by horses. The rim, or circumference of the wheel, is made hollow, and is divided into several compartments, to form a number of boxes or buckets; each bucket has an opening into it at that end which will be the most advanced when the wheel turns; and from this opening, a spout or trough projects in a direction parallel to the axis of the wheel. When the wheel revolves, the buckets dip into the stream, and become filled with water; but as the mouths or spouts are at the upper end when the buckets rise out of the water, they cannot escape, and each bucket carries up its charge of water to the top of the wheel; but the buckets will have then become inverted, and the spouts or openings being at the lowest part, that they discharge the water sideways through the spouts into a trough properly placed to receive it, and then the buckets descend empty till they dip into the stream and are refilled. The objection to this machine is, that the buckets begin to pour out the water
some time before they arrive at the greatest height of the wheel; and, therefore, the trough is of necessity placed lower than the diameter of the wheel, or a considerable portion of the water would be lost, and in any case part of the water is raised above the level of the trough.

Spanish Bucket-Wheel.—Mr. Townsend, in his Travels through Spain, describes a simple machine which is used at Narbonne for watering of gardens. The water is raised by a vertical wheel, which is twenty feet in diameter, on the circumference of which is fixed a number of little boxes or square buckets, for the purpose of raising water out of the cistern communicating with the canal below, and to empty it in a reservoir above, placed by the side of the wheel. The buckets have a lateral orifice to receive and to discharge the water. The axis of this wheel is embraced by four small beams, crossing each other at right angles, and tapering at the extremities so as to form eight little arms. This wheel is near the centre of the path in which the mule walks, and contiguous to the vertical axis, into the top of which the horse-beam is fixed; but near the bottom of this axis it is embraced by four little beams, forming eight arms, similar to those above described, on the axis of the water-wheel. As the mule which they use goes round, these horizontal arms, supplying the place of cogs, take hold each in succession of these arms which are fixed on the axis of the water-wheel, and keep it in rotation. This machine may be made very cheap, and will throw up a great quantity of water, yet undoubtedly it has two defects; the first is, that part of the water runs out of the buckets, and falls back into the well after it has been raised nearly to the level of the reservoir; and the second is, that a considerable proportion of the water to be discharged is raised higher than the reservoir, and falls into it only at the moment when the bucket is at the highest point of the circle, and ready to descend.

The Persian wheel with swinging buckets is free from some of the defects of the last machine. The buckets are loose, and each hangs from the circumference of the wheel by a pin, on which it swings or turns freely; and as the bucket is suspended by its upper part, it will hang perpendicular, with the mouth upwards, in all positions of the wheel. From the time it dips in the water and is filled, until the bucket arrives at the upper part of the wheel, it is carried by the motion of the wheel against the edge of the trough, and inclined so far as to discharge its contents into the trough. (See Persian Wheel.) The pins are fixed into the circumference of the wheel, and project sideways therefrom a sufficient distance to support the buckets, and carry them over the elevated trough. Sometimes the wheel is made with two rings, and each bucket is suspended upon an axis between them: the end of each axis passes through the rim of the wheel, and is bent to form a short lever, which is carried by the motion of the wheel against a fixed rail, and thus inclines the bucket to discharge the contents into a trough which is fixed to the rings of the wheel immediately beneath the bucket, and has a spout projecting at the side of the wheel, to carry the water sideways and deliver it into the trough, which is fixed at the side of the wheel for its reception.

As the Persian wheel is a very effective machine in situations where the elevation is required to be but small, the following directions, given by M. Belidor for its construction, are worthy of attention: first fix the diameter of the wheel something greater than the altitude to which the water is to be raised; fix also upon an even number of buckets, to be hung at equal distances round the periphery of the wheel; and mark the position of their centres of motion in such a manner, that they will stand in corresponding positions in every quarter of the circle. Suppose vertical lines drawn through the centre of motion of each bucket in the rising part of the wheel, and they will intersect the horizontal diameter of the wheel in points, at which, if the buckets were hung, they would make the same resistance to the moving force, as they do when hanging at their respective places on the rim of the wheel. Thus, supposing there are eighteen equidistant buckets, then while eight hang on each side of a vertical diameter of the wheel, there would be eight on the other side, and two would coincide with that diameter: in this case, the resistance arising from all the full buckets would be the same as if one bucket hung on the prolongation of the horizontal diameter, at the distance of twice the fine of 25° + twice the fine of 40° + twice the fine of 60° + twice the fine of 80°, these being the fines to the common radius of the wheel.

To know the quantity of water that each one should contain, take four-ninths of the absolute force of the stream, that is, four-ninths of the weight of a prism of water whose base is the surface of one of the float-boards, and whose height is equal to that through which the water must fall in order to acquire the velocity with which the stream moves. This is the power which should be in equilibrium with the weight of water contained in the buckets of the rising semicircle. Then, as the sum of the fines mentioned above is to the radius of the wheel to the centre of the float-board, so is the power just found to a fourth term, one-half of which will be the weight of water that ought to be contained in each bucket. Lastly, the velocity of the float-board of the wheel will be that of the stream nearly as one to two and two-fifths, and from this the number of revolutions it will make in any determinate times may be known, and of consequence the quantity of water the wheel will raise in the same time, since we know the capacity of each bucket, and the number of them which will be discharged in every revolution of the wheel. See Persian Wheel.

The Chinese Bucket-Wheel.—Sir George Staunton, in his account of the Embassy to China, gives the following description of a bucket-wheel, which is different from any we have met with in the hydraulic collections, and constructed with that simplicity which distinguishes the Chinese inventions. Two hard-wood posts or uprights are firmly fixed in the bed of the river, in a line perpendicular to its banks. These posts support the pivots of an axis of about ten feet in length: this is the axis of a large wheel consisting of two unequal rims, the diameter of the rim which is nearest to the bank being about fifteen inches less than that of the outer rim; but both rims dip into the stream, while the opposite parts or top of the wheel rise above the elevated bank over which the water is to be raised. This double wheel is framed upon the axis, and is supported by sixteen or eighteen spouts, inverted obliquely into the axis near each extremity, and croffing each other at about two-thirds of their length. They are there strengthened by a concentric circle, and are fastened afterwards to the two rims. The spouts inverted in the interior extremity of the axis reach to the outer rim, and those proceeding from the exterior extremity of the axis reach to the inner and inner rim. Between the rims and the croffings of the spouts is a triangular space, which is wove with a kind of cloze basket-work, to serve as ladle-boards, or floats. These successively receiving the current of the stream, obey its impulse, and turn round the wheel.

The buckets which take up the water are small tubes or spouts.
WATER.

Points of wood attached to the two rims of the wheel, and having an inclination of about twenty-five degrees to the horizon, or to the axis of the wheel. The tubes are closed at their outer extremities, which are fixed to the larger rim, and open at the opposite end. By this position the tubes, which in the motion of the wheel dip into the stream, have their mouths or open ends uppermost, and fill with water. As that segment of the wheel rises upwards, the mouths of the tubes attached to it will alter their relative inclination, but not so much as to let their contents flow out until such segment of the wheel arrives at the top. The mouths of these tubes are then relatively depressed, and they pour the water into a wide trough placed on pivots, from whence it is conveyed, as may be wanted, among the plantations of canes.

The only materials employed in the construction of this water-wheel, except the nave or axis, and the posts on which it rests, are afforded by the bamboo. The rims, the spokes, the ladle-boards or floats, and the tubes or spouts, or even the cords, are made of entire lengths, or single joints, or large pieces, or thin slices, of the bamboo. Neither nails, nor pins, nor screws, nor any kind of metal, enter into its construction: the parts are bound together firmly by cordage of split bamboo. Thus, at a very trifling expense, is constructed a machine, which, without labour or attendance, will furnish, from a considerable depth, a reservoir with a constant supply of water, adequate to every agricultural purpose.

These wheels are from twenty to forty feet in diameter, according to the height of the bank, and consequent elevation to which the water is to be raised. A wheel of thirty feet is capable of filling a tank with twenty wheels or spouts, of the length of four feet, and diameter of two inches in the clear. The contents of such a wheel would be equal to six-tenths of a gallon, and the twenty wheels would hold twelve gallons. A stream of a moderate velocity would be sufficient to turn the wheel at the rate of four revolutions in one minute, by which would be lifted forty-eight gallons of water in that short period; or in one hour, two thousand eight hundred and eighty gallons; and sixty-nine thousand one hundred and twenty gallons, or upwards of three hundred tons in a day. This wheel is thought by Sir George to exceed, in most respects, any machine yet in use for similar purposes. The Persian wheel, with loose buckets suspended to the edge of the rim or fellics of the wheel, so common in the south of France, and in the Tyrol, approaches nearest to the Chinese wheel, but is vastly more expensive, and less simple in its construction, as well as less ingenious in the contrivance. In the Tyrol there are also bucket-wheels for lifting water in a circumference of wood, hollowed into scoops; but they are much inferior either to the Persian or Chinese wheel.

Chain of Buckets.—This machine consists of a number of buckets attached to a chain or rope, the ends of which are united together. The chain is conducted over a wheel, which is turned by some animal or mechanical power; and the chain hangs down from this wheel into the well from which the water is to be drawn. The buckets at the lower part of the chain become filled, and, by the motion of the chain, the buckets attached to one part of the chain will ascend full of water, whilst those on the opposite side are descending empty, with their mouths downwards. When the full buckets of water turn over the upper wheel, they discharge their contents into a trough fixed near the wheel. The most convenient way of discharging the water is to make the upper wheel hollow, with divisions in it like the tympanum; and the buckets, when they turn over, will pour their contents into the hollow segments of the wheel, and it will run off through a hollow in the axis made for that purpose. The advantage of the chain of buckets over the wheel is, that the chain can be made to descend in a well, or small space, where the wheel could not; also, that the chain may be used for greater depths than would be practicable for a wheel.

The Spaniish noira is a chain of buckets or earthen jars.

Mr. Townsend informs us, in his journey through Spain, that the noira consists of an endless band or girdle, falling over a pin-pocket-wheel: the band is long enough to reach eighteen inches or two feet below the surface of water in a well. All round this band, at the distance of about fifteen inches, are fixed jars of earthen-ware, which, as the band turns, take up water from the well, and pour it into a cistern fitted to receive it. A little afs, going round in a circular walk with ease, turns a trundle, which gives motion to a cog-wheel, fixed on the face axis with the pinocket-wheel, on which the band is hung, and with which it turns. This machine produces a constant and considerable supply of water, at a small expense, and with very little friction. As the air would obstruct the entrance of water into the earthen jars or bottles, each jar has a little orifice in its bottom, through which the air escapes; but then water runs out also, and a certain quantity falls back into the well.

It is true, as the jars rise in one straight line, the water which runs out of the superior jar is caught by that which is immediately below it, yet still there is a loss; and, besides this inconvenience, the whole quantity is raised higher than the upper reservoir, at least by the diameter of the pinocket-wheel, because it is only in its descent that the jars are emptied.

The screw of Archimedes is a machine on a principle very closely allied to the horn-wheel; but the curved channels are wrapped spirally round an axis, which is placed on an inclined position, with the lower end immersed in the water which is to be raised, and the upper end placed over the edge of the reservoir into which the water is to be delivered. When this cylinder is turned round, it will take water up in its spiral channel, and raise it gradually to the elevated end, and discharge it into the reservoir. (See Screw.) Although this machine is simple in its general manner of operation, its theory is attended with some difficulties.

If we conceive that a flexible tube is rolled regularly about a cylinder, from one end to another, this tube or canal will form a screw or spiral, of which we suppose the intervals of the spires or threads to be equal to one another. Suppose this cylinder placed with its axis in a vertical position, if we put in at the upper end of the spiral tube a small ball of heavy matter, which may move freely, it is certain that it will follow all the turnings of the screw from the top to the bottom of the cylinder, descending always as it would have done, had it fallen in a right line along the axis of the cylinder; only it will occupy more time in running through the spiral.

If we suppose the cylinder placed with its axis horizontally, and we again put the ball into one opening of the canal, it will descend, following the direction of the first demi-spiral, until it arrives at the lowest point in this portion of the tube, and then it will stop: for the weight of the ball has no other tendency than to make it descend in the demi-spiral. The oblique position of the tube, with respect to the horizon, causes the ball, in descending, to advance from that extremity of the cylinder whence it commenced its motion to the other extremity. When the ball is arrived at the bottom of the first demi-spiral, if we cause the cylinder to turn on its axis, without changing the position
of that axis, and in such manner that the lowest point of the demi-spire on which the ball presses becomes elevated, then the ball falls necessarily from this point upon that which succeeds, and becomes lowest; and as this second point is more advanced towards the second extremity of the cylinder than the former one, the ball will be advanced towards that extremity by this new descent, and so on, that it will at length arrive at the second extremity. Moreover, the ball, by constantly following its tendency to descend, has advanced through a right line, parallel and equal to the axis of the cylinder; and this distance is horizontal, because the sides of the cylinder were placed horizontally.

But suppose the cylinder had been placed oblique to the horizon, and turned on its axis continually in the same direction, it is easy to see that the ball will move from the lower end of the spiral tube towards the upper end, although it is actuated solely by gravity, for this causes it to occupy the lowest point of the first demi-spire; and when it is abandoned by this point, as it is elevated by the rotation, and will roll by its weight upon that point which has taken its place, this succeeding point is further advanced towards the elevated extremity of the cylinder than that which the ball occupied just before; consequently the ball, while following its tendency to descend, will be always more and more elevated, by virtue of the rotation of the cylinder. Thus it will, after a certain number of turns, be advanced from the lower extremity to the upper, or through the whole length of the spiral; but it will only be raised through the vertical height, determined by the obliquity of the position of the cylinder.

Instead of the ball, let us now consider water as entering by the lower extremity of the spiral canal, when immersed in a reservoir. This water descends at first in the canal solely by its gravity; but the cylinder being turned, the water moves on in the canal to occupy the lowest place, and thus, by the continual rotation, is made to advance further and further in the spiral, till at length it rises to the upper extremity of the spiral, where it is expelled. There is, however, an essential difference between the water and the ball; for the water, by reason of its fluidity, will adapt itself to the form of the spiral, and, after having descended by its heaviness to the lowest point of the demi-spire, will rise up on the contrary side to the original level; on which account, more than half one of the spires may be filled with the fluid.

The most simple method of tracing a screw or a helix upon a cylinder is well known to be this:—Take the height or length of a cylinder for the perpendicular leg of a right-angled triangle, and make the base or horizontal leg equal to as many times the circumference of the cylinder as the screw is to make convolutions about the cylinder itself; then draw the hypotenuse to complete the triangle. Suppose this triangle to be enveloped about the surface of the solid cylinder, the perpendicular leg being made to lie parallel to the axis of the cylinder, and the horizontal leg or base to fall upon the circumference of the cylinder, even with its base; then the hypotenuse or sloping side of the triangle will form the contour of the screw. If a tube be formed according to the direction of this spiral, and a small ball put into it when the cylinder is placed upright, the ball would roll to the bottom with the same velocity, and the same force, as it would have descended upon a plane surface, inclined in the same degree as the hypotenuse of the triangle which we have supposed, when the base thereof is horizontal. But suppose the cylinder be inclined in such degree, that the hypotenuse of the said triangle would be horizontal instead of the base, as the angle which the threads of the screw make constantly with the base of the cylinder is just equal to that inclination, the threads at their point of smallest inclination will be parallel to the horizon; so that there being nothing to occasion the ball to roll towards either end, it will remain immovable, supposing the cylinder to be at rest; but if the cylinder be turned on its axis in one direction, the ball (abstracting from friction) will move the contrary way, in conformity with the first law of motion. The inclination which we have just supposed is the least we can give, so that the ball shall not descend of itself; but if we augment this inclination, then, by turning the cylinder, the ball will always have a descent on one side, and will in consequence roll towards the elevated end of the same, and will mount by descending. The reason is very simple: the plane which carries it makes it rise more, in consequence of the rotatory motion, than it descends by virtue of the force of gravity. It is obvious, from what has been remarked, that this screw can never raise water, when the angle which the central line of the spiral makes with the base of the cylinder is larger than the angle which the base of the cylinder makes with the horizon.

The ratio of the weight of the ball to the force which is necessary to make it rise by turning the screw, is as the vertical space through which the weight is raised to the space passed through by the power in moving it. Suppose the moving force acts at the circumference of the cylinder, the space passed over by that force will be equal to as many times the circumference of the cylinder as the number of convolutions of the helix. Let the diameter of the cylinder be 14 inches, the vertical altitude of the upper end of the cylinder above the lower end 12 feet, or 144 inches, and 12 convolutions of the spiral: let the cylinder be so placed, that the inclination of the axis is greater than the inclination of the spiral to the axis, and let the weight to be raised be 48 lb. ball. The circumference of the cylinder will be nearly 44 inches, and the 12 turns equal to 12 \times 44 = 528 inches, for the space the power must move through. Hence we have 528 inches : 144 inches :: 48 lbs. : 13 \frac{1}{2} lbs.; the measure of the requisite force to be applied at the surface of the cylinder. If the moving force describes a circle whose diameter is three times that of the cylinder, or acts at a winch whose distance from the axis of motion is 21 inches, that force will then be reduced to \frac{1}{3} of 13 \frac{1}{2} or 4 \frac{1}{2} lbs. which is less than one-tenth of the weight of the ball. In this investigation, no notice is taken of the friction upon the pivots, or of the effects of the air included in the spiral: yet if the spiral had been folded upon a cone instead of a cylinder, or if it had been formed of a flexible tube of varying diameter, these effects would have been important: some of them are considered in our account of the spiral pump.

The Archimedes' screw is a machine so frequently employed in hydraulic architecture, as to deserve particular directions for constructing it. The simple pipe wrapped round a cylinder will not afford any considerable supply of water, and therefore a hollow barrel must be made with one or two spiral partitions running in it, like the spiral staircases used in church steeples.

Vitruvius has given minute directions for the construction of the water-screw, and Mr. Smeaton's directions, which are very similar, are as follows:—For a screw of 18 inches diameter, use a solid cylinder of six inches diameter as an axis, upon the surface of which cut a double helix, forming two separate grooves round the axis of about three-quarters of an inch wide and deep, so that the grooves in going once round will advance about sixteen inches, and in consequence...
consequence the two grooves will be eight inches apart from middle to middle, measuring parallel to the length of the cylinder. Into these grooves drive and fallen pieces of board, so as to form radii or sectors of a circle of eighteen inches and a half diameter, and so moulded as to be a little upon the twist, to answer the different inclinations of the helix, at the different distances from the centre. These pieces being jointed together, and to the axis, so as to fill the whole groove from one end of the axis to the other, form a double screw; then apply narrow boards longitudinally, reaching from one end of the screw to the other. The boards should be about four inches broad, and formed concave within side, anfwerable to a circle of eighteen inches diameter. These boards are marked one by one at the places where they touch the spiral boards, and are then grooved about a quarter of an inch, to admit the ends of the radius pieces which form the screw. When all the boards are put together they form a cylinder of eighteen inches diameter, which is hooped on the outside, in the manner of a tub or cask; and in order that the hoops may properly drive on the outside, at the same time that the inside forms a complete cylinder, the longitudinal pieces are made rather thicker in the middle than at the ends.

Archimedes' screw may be used for other purposes than raising of water. It might be adapted with advantage in raising cannon-balls from a ship to a wharf, and with the addition of a bevel-wheel or two and their pinions, might be worked either by men or horses. Sometimes Archimedes' screw instead of being worked by men at a winch, is turned by means of float-boards fixed on the circumference of a wheel placed at its lower end, upon which a stream of water acts. If the water has a moderate fall, it will have sufficient efficacy to turn two screws, one above another. The top of the lower screw and the bottom of the upper screw may act one upon the other, by means of a wheel upon each, with an equal number of teeth taking into each other. In this case the upper screw will turn in a contrary direction from the lower, and consequently the spiral tube must be wound about the cylinder in an opposite direction. A solid wheel, or a light wheel with a heavy rim, turning upon the middle of the screw as an axis, will operate like a fly, and in some cases be very useful.

Mr. Smeaton made a machine to raise water by an Archimedes' screw for the royal gardens at Kew, which was on a large scale. The screw was twenty-four feet long, two feet six inches in diameter, and raised the water perpendicularly fourteen feet nine inches. The central cylinder, or shaft of the screw, was ten inches diameter; the distance between the threads, including the thickness of the helix, was twelve inches and a half; and as there were two spiral palfages, each spiral advanced twenty-five inches along the cylinder at every turn; each spiral contained twenty-four quarters at every turn which it made.

This screw was turned by means of a trundle or pinion from a horse-wheel, with the intervention of two moveable joints, to change the direction of the axis from the horizontal to the direction of the axis of the screw, which was inclined at an angle of about thirty-eight degrees to the horizon. The diameter of the horse-track was twenty-five feet, half of which was the length of the effective lever upon which the horses acted. The great cog-wheel on the axis of the levers was fourteen feet diameter, with 144 cogs, and the trundle which it turned twenty-three cogs, so that the screw made about six turns for one of the horse-wheel.

This machine was worked by two light horses, with very great ease, and they made three turns per minute; but if at all urged, could make the screw turn twenty turns per minute, and at that rate of working raised 300 hogsheads per hour.

The Water-screw, described in our article Screw, does not differ from the screw of Archimedes in its principle, but as the screw turns round within a fixed barrel, the water is liable to leak back in part.

Drawing Water by Buckets.—The methods which we have hitherto described are only adapted to raise water to small elevations; but by means of buckets, water may be drawn from very great depths. The most simple cafe is that of a man with a bucket or other vessel in his hand, slopping down to lower the empty bucket into a pond, as low as he can reach, and drawing it up full of water.

The first improvement which would occur would be to suspend the bucket by a rope, and draw it up by means of a long lever, or otherwise, if the depth was greater, by continuing the rope over a pulley, so that the man could easily draw the end of it; and this would be further improved when two buckets were suspended at the opposite ends of the rope or chain, so that one being drawn up full of water, an empty one would be let down at the same time. This method is applicable to the deepest well, and is very effective. The addition of a windlass and crank would be a successive improvement, and could be made to act either finely, to draw up one bucket, or double, to let down an empty bucket at the same time it drew up another loaded with water.

The drawing up of a bucket by a rope and pulley is so simple and obvious as to need no explanation. The bucket should be of such a size that it will not weigh above twenty-five pounds, and will therefore contain nearly half a cubic foot of water. For although a man could with ease raise a much greater weight, yet he would be unable to draw it up quickly, or to work at it throughout the day; and what he would gain by the increased quantity of water, he would lose in the time which it would require to draw up the bucket, and in the time he would require to rest himself from his fatigue. If the rope is conducted horizontally, and the man takes it over his shoulder and walks along the ground, his force will be applied in a much more effective manner than by simply hauling the rope over a pulley; and a horse may be applied in the same manner with a larger bucket, and there is perhaps no better mode of applying the force of a horse for a deep well. The bucket should not in this case weigh above a hundred and twenty pounds, or it must not contain above two cubic feet to enable the horse to draw it with that velocity which is most natural to him.

When a windlass is employed to wind up the rope, the winch or crank, which is applied to the axis of it, can be made much larger than the radius of the windlass, and in consequence the power may be increased so much that a larger bucket may be drawn, which is some advantage, because less time will be lost in slopping to fill and empty the bucket, otherwise nothing is gained in drawing up a large bucket, because it must move slower in proportion to its increased weight; but in all cases the length of the handle should be about fourteen or sixteen inches, to enable a man to turn it with ease, and the weight of the bucket must be so adapted to the size of the windlass, that the power required at the handle will not be above thirty pounds or even twenty-five pounds, if a man is to work continually for six or eight hours in a day. For example, suppose the bucket be about forty-five pounds weight, and the handle sixteen inches long, then as 46 is to 25, so is 16 to 8. Therefore, from which
which deduct half the thickness of the rope, and it leaves the proper radius for the roller or windlafs. A rope of the proper size for this purpose will be about two inches and a half in circumference, or rather more than three-quarters of an inch in diameter; hence the diameter of the barrel will be \(\frac{1}{2}\). If a fly-wheel is applied to the axis, it will be an advantage to equalize the force which the man applies, because some positions of a crank or handle are less favourable than others for the exertion of a man's strength.

It is most advantageous to employ two buckets, and as the rope for one unwinds whilst the other winds up, the weight of the two buckets balance each other, and the man has only the weight of the water to draw up.

**Bucket-Machines for deep Wells.**—When a machine to draw water by buckets is made on a larger scale, the windlafs is placed perpendicularly, and levers applied to it at the lower end, which may be actuated either by men, or by horses walking round in a circle on the ground, and drawing or pulling the lever of the bucket; in this way a powerful machine may be made, and if the depth is very considerable, it is a very good method. Many methods have been proposed to make the buckets fill themselves when at the bottom of the well, and empty when at the top: the best is to suspend the bucket in an iron loop or bow, like the handle of a pairle, but this should be made so long, that the pins on which the clock or bucket hangs, shall be but little above the centre of gravity of the bucket when loaded with water; in consequence, when the bucket is drawn up to the top, one edge of it is caught by a hook fixed on the edge of the cistern into which the water is to be delivered, and the bucket will continue to be drawn up whilst the hook retains one edge, the bucket is thereby overturned, and its contents discharged into the reservoir. It is requisite for this plan, that the bucket be made, by some contrivance, to present itself always in the same direction to the hook, so that it will be seized and overturned thereby: one method is to fix upright pieces of wood or iron in the well on each side of the bucket, and the pivots on which the bucket is poised project on each side beyond the iron loop on which the bucket hangs, and enter into grooves formed in these pieces, so as to be guided in the ascent and descent of the bucket. Another method is to make the rope of the bucket double for some feet immediately above the bucket, that is, the rope divides into two ends, each of which is made fast to the opposite side of the iron loop in which the bucket is suspended: the rope is made to pass through a narrow opening in a piece of plank, which will admit the double rope to pass freely, provided the bucket comes up in the required position; but if it does not, then the forked rope will be acted upon by the sides of this narrow opening in such a manner, as to turn the bucket round to the required position.

To make the bucket fill readily at the bottom of the well, a simple valve is made in the bottom, which opens upwards and admits the water, but shuts when the bucket is drawn up out of the water. In the Transactions of the Society of Arts, vol. xii, is a description of a machine by Mr. Kuffel, in which the bucket, when it is drawn up to the top of the well, acts upon a lever, and causes a moveable trough to run across the well beneath the bucket; and then as the bucket rises higher, a trigger, which belongs to the valve in the bottom of the bucket, is intercepted by a fixed piece of wood, so as to open the valve, and the water runs out of the bucket into the moveable trough which conveys it to the reservoir: when the bucket begins to descend, it allows the levers to return, and the moveable trough retreats from beneath the bucket, and allows it to descend again into the well to bring up a fresh charge. The moveable trough is made to run backwards or forwards over the mouth of the well, by means of wheels or rollers, on which it is supported, and these wheels run upon pieces of wood laid across the well.

**Indian Method of drawing Water by a leathern Bucket.—**

Dr. Roxburgh of Calcutta has given us a description of a method of raising a large quantity of water from a deep well by means of one or two buffaloes or bullocks, which is in common use in many parts of Hindoostan, where the wells are too deep for the lever. A pulley is erected over the well to receive a rope, which the animals draw by walking along an horizontal path in order to elevate a large bucket, and they return towards the well to lower it down: the bucket is made of leather, like a long funnel, extended at the top or mouth by a square frame of wood, or by a hoop, and the lower end terminates in a small open tube, which is flexible, and can be turned up; in which case, if the orifice of the tube is kept as high or higher than the mouth of the bucket, no water can escape through the tube, it is in this condition that the bucket is drawn up full of water: the end of the tube has a cord fastened to it, which is conducted over a roller fixed on the edge of the trough into which it is desired to deliver the water, and which trough must be at least the length of the bucket beneath the great pulley that is fixed over the well. The opposite end of the cord is tied to the great rope near the point where the buffaloes draw, and the cord is of such length as to hold the orifice of the tube rather above the mouth of the bucket, until the tube is drawn up to the roller. When the cord draws the tube over the roller, and leads its end into the trough as the bucket continues to be drawn up, it is raised above the level of the trough, by which means the whole of the water will make its escape through the orifice of the tube into the trough: when the bucket is let down again, the flexible tube returns over the roller, and the cord holds up its orifice above the top of the bucket.

Defaguiers, in the second volume of Experimental Philosophy, describes a very simple contrivance to raise water by a bucket; which is this, to one end of a rope is fixed a large bucket, having a valve in its bottom opening upwards; to the other end of the same rope is fastened a square board, something like the scale-board of a balance, but large enough for a man to stand upright in it; the cord is made to pass over two pulleys, each of about fifteen inches diameter, and fixed in such manner, that as the bucket descends, the scale ascends with equal velocity, and vice versa. The scale is made to run freely between four vertical guide rods, passing through holes at its four corners, and when the bucket is lowered down into the lower cistern in order to fill with water, the scale stands nearly level with the horizontal plane of the upper reservoir to which the water is to be raised. When the bucket is full, a man steps into the scale, and his weight, together with that of the frame, exceeding the weight of the vessel and its contained water, will give an ascending motion to the bucket, and causes the valve in its bottom to close. When the bucket is raised to the proper height, a hook which is fixed at the edge of the upper reservoir catches into a half at the side of the bucket, and turns it over, to caufe it to empty its water into the upper cistern, or into a trough, which conveys it where it is required: at this time the man and the scale have arrived at a platform, which prevents their further descent, and the man must remain in the scale till he finds the bucket above is empty, when he steps from the scale, and runs up a flight of stairs to the place from which he descended: the bucket in the mean while, being somewhat heavier than the scale, descends again to the water, and raises the frame to its original position; thus the work
WATER.

is continued, the man being at rest during its descent, and labouring in the ascents.

Defaguliers employed in this kind of work a tavern-drawer, who had been used to run up and down stairs; he weighed 160 pounds, and was defird to go up and down 39 steps of 6½ inches each (in all about 21 feet) at the same rate, he would go up and down all day. He went up, and down twice in a minute, so that allowing the bucket, with a quarter of a hoghead of water in it, to weigh 180 pounds, he is able to raise it up through 21 feet twice in a minute, which is equivalent to the whole hoghead raised 10½ feet in a minute, and rather exceeds what Defaguliers affigned as a maximum of human exertion; from experiments made with a mercurial pump. He recommends that the man in the scale should weigh one-fifth or one-sixth more than the weight of the water in the bucket, in order to give him a preparation to bring up the bucket with a proper velocity.

Balance Buckets.—This is an ingenious contrivance for raising water by the power of a small fall of water: supposing a wooden lever twenty feet long, poised upon a centre at five feet from one end, one arm will then be five feet long, and the other fifteen, or three times. At the extremity of the long arm a small bucket is fixed, and at the extremity of the short arm another bucket, which is rather more than three times as great in capacity: the lever is so poised, that it will place itself in an horizontal position when both the buckets are empty; but suppose that in this situation a small spout of water runs into each bucket, when they become both filled, the larger bucket at the end of the short arm will overweigh the smaller one, because it holds more than three times as much water; in consequence, the larger bucket will descend and move the lever into a perpendicular situation, by which means the small bucket is raised fifteen feet above the level of the spout at which it received the water, whilst the great bucket has descended five feet beneath its source of supply. Both the buckets are suspended to the ends of the lever on pivots, so that they can readily be turned over to discharge their contents; this takes place when the lever arrives near its vertical position: the small bucket is caught by a hook, and overturned into the elevated trough which is to receive the water, and immediately the lower bucket is emptied by similar means. The long end of the lever is now the heaviest, and in consequence the lever returns to its horizontal position, in which it remains until the buckets are both full, and then it makes another stroke.

A simple contrivance is applied to stop the running of the spout of water during the time that the lever is in motion, to prevent waste of the water.

The lifting and gaining Buckets is a simular machine to the preceding, but admits of raising the water to a greater height, because chains and wheel-work are employed instead of a lever. This machine will raise water sufficient to serve a gentleman's feat, with an overplus for fountains, fift-ponds, &c. A machine of this kind can be erected wherever there is a spring affording a small supply of water, and having even so small a fall as ten feet. It is possible, by this invention, with the loss of part of the water, to raise the spout, to supply a house, or any place where it is required; but, of course, it must be in a less quantity than the fall of water which is to actualize the machine, nearly in the same proportion as the place to which the water is to be raised is higher than the fall of the spring. For example, the fall of one hoghead through ten feet will raise about one-sixth of a hoghead to the height of forty feet. This machine had been conceived by Schottus about 9 years ago, and he gave a draught of it. It is described in Leopold's Théaturum Machinarum Hydraulica rum, 1720; but it was never put in execution to any good purpose in England, till Mr. George Greaves, a carpenter, erected an engine upon this principle, about 1730, for Sir John Cheffter, baronet, at his seat at Chickley, in Buckinghamshire; a sketch of which is given at fig. 15, Plate Water-Works. A small spring of water, supplying four gallons per minute, is conveyed seventy-two yards, by a gutter, into a ciferin N, containing about twelve gallons. This water has a descent to the other ciferin at R, ten feet below X; from the latter, the water is conveyed off along H, by a drain or fewer. The descent of part of the water through this ten feet is the motive force to work the machine. A, B, are two copper pans, or buckets, of unequal weights and sizes, suspended by chains, which alternately wind off, and on the two multiplying-wheels Y and Z, whereas the wheel Y is smaller in diameter, and Z larger, in proportion to the different lifts each bucket is designed to perform. A house is built over the well or ciferin, with three floors, for the convenience of fixing the parts of the engine. On the uppermost floor is fixed a frame of timber 2 2, in which the moving parts are supported, as is shown, (part being broken off in the figure, to explain the work): across this frame lies an horizontal axis G, three feet and a half long, moving on two gudgeons in braffles. Upon this axis are framed three wheels; first, the small wheel Y, which is two feet diameter, and shrouded, or made with a raised rim at each side; the edge of the wheel is five inches broad, and shod with iron. Upon the wheel Y is fixed a chain, made very flat and flexible, which, after it had wrapped once round the wheel, is then made double, that it may lie on each side of the edge part, the double parts having a sufficient opening between them to admit the single part, and this prevents fretting or galling, and keeps the chain exactly perpendicular: from the extremity of the double part is hung a long rod of iron, at the bottom of which the great bucket A is fixed. The largest wheel Z on the axis is fix feet diameter, and one inch and a half broad on the face, which is also shrouded: this wheel is not circular, but spiraled two inches, both in the fole and in the shrouds; so that its radius at the fole part is two inches less than three feet. Upon the large wheel Z is fixed a smaller chain, to suspend the bucket B: it is made like the former, and so arranged, that when the wheel Z has made one revolution from left to right, the spiral fole will take up a certain length of the chain. After this length, the lower or remaining part of the chain has crofs-bars fixed to it, at equal distancies, which fall upon the edges of the shrouds into notches plated with iron: by this means, and by the help of the spiral, this part of the chain is not only prevented from riding upon the other, but helps to equipostrate the increase of weight of the other chain of the bucket A. A third wheel r, three feet ten inches diameter, is fixed on the axis G, between the other two wheels: it is also shrouded like the others, and is spiraled three-fourths of an inch; it receives a rope, the lower end of which goes about a wheel d, of two feet diameter, to which end is fixed, and on the axis, d, of this wheel is another, t, one foot diameter, and to this is fastened a rope, which goes down upon the quadrant ab, which carries a sealing weight in a box at the extremity of the arm Q; the quadrant a moves on the axis b, and the rope descending from the wheel t is guided between iron plates, upon the circumference of the quadrant. The box, at the end of the arm Q, contains a sealing lead weight, to counter-balance the weight of the chains, by keeping an exact equilibrium in every position of the machine. Besides the action of the quadrant, the motion is regulated by wheel-work, like that of a jack; thus, upon
one end of the axis G, is a strong iron wheel M, giving motion to a pinion m, and by means of a wheel and worm n and o, to a fly P, which regulates the motion of the engine, and prevents any improper acceleration from the unwinding of the chains. The small bucket B is made of copper, about five gallons in capacity; it has a valve in the bottom, by which the bucket will be filled when it descends into the water of the cistern N. The bucket is suspended in an iron link, or handle, upon two pivots, so that it can be very easily turned over upon them. This happens when it is drawn up to F, the edge of the bucket catching a hook which overturns it, and discharges the contents into the trough W, at an elevation of thirty feet above X, and whence it is conveyed by pipes wherever it is wanted.

The great bucket A is likewise made of copper, and contains about fifteen gallons when drawn up to the position A: it is filled with water from a valve, or sluice, in the side of the cistern N, which is then opened by a bent lever, whereof the end projects, so that the bucket will lift it up. In the bottom of the bucket is a spindle-valve, which is opened when the bucket has descended to R, by the end of its spindle resting on the bottom of the well. Iron rods are fixed vertically to guide both the buckets, which have ears with braze rollers in them, and incline three sides of each, which is square, and they are thus caused to ascend and descend in a perpendicular line, and no other.

The operation of the machine is as follows:—When the buckets are empty, they are dropped, as shown in the figure on a level with the spring at X, whence they are both filled with water at the same time, in the manner just described.

The greater of the two A, being the heavier, when full preponderates, and descends ten feet from C and D, and the lesser B, depending from the same axis, is at the same time weighed up or raised from B to F thirty feet.

Here, by catching the hook F, the small bucket discharges its water into the trough W, and thus suddenly losing weight, it lets the great bucket down an inch lower, and the valve in the bottom is opened, in order to let out its water, which runs with the drain below at H. The bucket B being then empty, is so adjusted as to overweigh, and descending steadily as it goes, betwixt the guiding-rod, it brings or weighs up A to its former level at X, where both being again replenished from the spring, they thence proceed as before. And thus will they continue constantly moving, (merely by the circumstance of difference of weight and water, and without any other assistance than that of sometimes giving the iron work a little oil,) so long as the materials shall last, or the spring supply water.

The head of the motion is, in part, regulated by the fly P, which not only keeps the engine to an equal velocity, but by its running forwards, after the buckets are quite up or down, holds them steady till they are completely filled or emptied, and prevents them recoiling back too soon.

In order to counterbalance the weight of the chains in every position, the wheels r, d, and t, are so calculated, that during the whole performance up and down, they let the quadrant a move no more than one-fourth of a circle; by which contrivance, as more or less of the chains which suspend the buckets come to be wound off their respective wheels Y and Z, this weight gradually increases its action as a counterbalance, and so continues the motion equal and easy in all its parts. The spiraling of the wheels Y and Z help, in some measure, to regulate the weight of the chains in every position, as they act in winding on and off the wheels; but the quadrant ab, and lever with the weight Q, complete the equilibrium, by acting with the greatest force, because the lever is in the horizontal position when the chain of the great bucket A is all down, and weighing upon the wheel, the weight Q then acts with its whole weight upon the wheel r, as that chain is drawn up, its acting weight is thereby diminished, and the lever of the weight Q is moving down towards its perpendicular, whereby the weight Q diminishes equally in its influence on the motion of the wheel r, until it hangs perpendicularly, and its weight ceases to act; but the sliding-weight then runs down in its box, to keep the rope tight, the sliding-weight being attached to the end of the rope, and not to the lever. At the first return, or re-ascending of the great bucket, the weight Q is drawn up to a shoulder, before any motion is given to the lever of the quadrant; but whilst the long chain of the small bucket evolves from its wheel Z, the acting-weight of the quadrant is continually increasing, and at the same time the other chain of the great bucket wrapping itself upon the wheel Y, its acting weight is decreasing. The lever of the quadrant rising higher, brings the line of direction of the weight Q farther from the centre of the quadrant, and so lays a greater force or obstruction to retard the wheel r, and continually keeps a counterbalance.

This engine, at a slow motion, carries up one bucket full in five minutes; but if the spring ran double the quantity, it would go up twice in the same time, and an engine of this kind may be made to raise one hundred per minute, or more, if required, the consumption of water is less than what is spent by a water-wheel to raise an equal quantity of water to the same height.

The Endless Rope to raise Water.—This is a most simple contrivance, and will raise up a small quantity of water from a very considerable depth. A soft hemp or hair-rope, with the ends spliced together, is suspended over a large wheel, which is turned by a handle; the rope must hang down into the well, and reach some distance into the water, and a similar wheel may be placed beneath the surface of the water for the rope to pass under; but this is not necessary when the length of the rope is such, that its own weight will make it apply close to the upper wheel. The upper part of the rope must descend through a tube, which is fixed in the bottom of the cistern, or reservoir, to prevent the water running down with the rope; the tube is of such size as to fit the rope very nearly, but to cause any considerable friction. The rope is put in motion by turning the handle of the wheel, and the motion must be in such a direction, that the rope where it passes through the tube in the cistern shall descend.

The consequence is, that the water in the well adheres to the rope, and surrounds it like a film, or covering of water; but when the rope passes over the wheel, some of the water is thrown off by the centrifugal force, and falls into the reservoir, and that part of the water which escapes the action of the wheel is separated from the rope by the tube through which the rope passes; for it is to be observed, that the film of water which surrounds the rope is put in motion, whilst it is in the well, by the lateral adherence of the water to the rope, which motion being continually kept up, is sufficient to overcome the gravity of the water; but if any body is presented to the rope, so as to retard the motion of the water, without obstructing the motion of the rope, the water will fly off, and, losing its motion, will obey the action of gravity, and fall down.

The velocity with which the rope requires to be moved, will depend upon the depth from which the water is to be raised. The length of that part of the rope which is immersed in the water is also of some consequence, for if it must be such, that the rope will act upon the still water which
WATER.

which immediately surrounds it, until it has put that water in motion with nearly the same rapidity as the rope, and then such portion of water will accompany the rope; but this cannot take place without communicating a flower motion to a much larger quantity of water, which will also accompany the rope with a flower motion; but being too far removed from the rope to have its motion accelerated, or even maintained, its velocity will continually decrease, until it ceases to advance, and then it will begin to run back. But this is to be understood only of that part of the water which is too far distant from the rope to have its motion fully maintained by the lateral action of that water which is nearer to the rope, and which moves with nearly the same velocity as the rope. If the rope is examined at the point where it rises above the surface of the water, it will be found to be surrounded by a column of water which is of considerable size at the base, but diminishes as it rises upwards, somewhat in the form of a trumpet, so that at a few feet in height it is but little larger than the rope. This column of water is composed of several laminas, each moving with a different velocity; for instance, the interior part moves nearly as quick as the rope, the water which is more distant from the rope moves slower, until there must be a part in which the water remains immovable, and all the water which is beyond this, and on the outside of the column, runs downwards, and falls back into the well. On this account, the machine loses a considerable part of the power which is applied to it without producing an adequate effect.

This machine was invented by the Seur Vera, in France. A machine was made by him with a wheel three feet diameter, and a hair-rope of half an inch diameter, the well was ninety-five feet deep. A man could turn the wheel sixty times per minute, which gives a velocity of five hundred and sixty-five feet per minute for the rope. It brought up six gallons per minute, but was severe labour for one man. When the wheel was made fifty turns, and the rope moved four hundred and seventy-one feet per minute, the machine still raised a considerable quantity of water; but if the motion was reduced to thirty turns, or two hundred and eighty-two feet per minute, it brought up scarcely any water. A rope of hair is preferable to hemp, because it is less subject to decay; and when a hemp-rope begins to rot, it communicates a taint to the water.

The Sucking-Pump has a valve at the bottom of the barrel, and also another valve in the piton, which is called a bucket, because it brings up the water before it. This pump does not raise water when the bucket is let down, but only when it is drawn up, which is in some cases an inconvenience; and another objection is, that it cannot raise water to a greater height than the place where the water is applied, because there must be an opening for the pump-rod to come out at, and the water would flow out at the same opening, if it was raised as high. This inconvenience is remedied by the Lift-Pump, which has a valve in the bucket, the same as the sucking-pump, but it differs from it in the manner of communicating the force to the piton or bucket: one way of effecting this is to make the barrel open at the lower end, and the rod from the bucket, instead of being fixed to the upper side of the bucket, is fixed to the lower side, and comes out beneath the surface of the water in which the barrel is immersed. Rods are jointed to this, and rise up parallel to the barrel, in order to be attached to the lever by which the pump is to be worked: the fixed valve is placed at the top of the barrel above the bucket; this is the old-fashioned lift-pump.

The Lift-Pump, with a Stuffing-box, called sometimes a jack-head pump, is exactly the same as the sucking-pump, except that the top of the barrel is covered by a lid, which has a hole in the centre for the rod to pass through: the rod is made very smooth and true, and the hole is so formed as to contain collars of leather, which fit close round the rod, and prevent the escape of any water by the side of the rod. The water mounts up a pipe which communicates with the upper part of the barrel.

Another form of lift-pump has been recently introduced, in which the piton is solid, having no valve in it, and the rod passes through a stuffing-box or collar of leather in the top of the barrel, the bottom of the barrel being open. Two pipes are made to communicate with the barrel at the upper part; one of which brings water from the well into the pump when the piton descends, and has a valve in it to prevent the return of the water; the other pipe conveys the water away from the barrel when the piton is drawn upwards, and this is likewise furnished with a valve to prevent the return of the water.

One advantage of this kind of pump is, that both valves are situated in boxes near the top of the barrel, and can be examined and repaired at any time by taking off the doors or covers of the boxes; but in pumps where there is a valve at the bottom of the barrel, it sometimes happens that the valve fails, and requires to be repaired, when the water in the well stand higher than the cover or door of entry to the valve: in this case, some other means must be used to reduce the water in the well, or else the pump must be drawn up out of its place, which, in large works, is very difficult. Another advantage is, that the apertures of the valves may be made of any required dimensions to let the water pass freely through them; but when the water must come up through a valve in the bucket or piton, the passage through the valve must necessarily be much smaller than the barrel, to allow a proper lodging all round for the valve and also for the leathers.

The Force-Pump.—This is made with a solid piton, like the last, but the barrel is open at the top, where the piton-rood comes out. There is a valve at the bottom of the barrel to admit the water into it, and a pipe, which turns sideways out of the barrel at bottom, and has a valve to prevent the water returning into the barrel, to convey the water to whatever place it is to be forced to. The force-pump raises water only when the piton is pressed down, whereas the lift-pumps and sucking-pumps raise the water when the buckets are drawn up.

The Lift and Force-Pump of M. de la Hire.—This is the union of the two last pumps in one, for both these pumps work with a solid piton, and the barrel of the force-pump is open at top, and the barrel of the lift-pump is open at bottom; hence the same barrel and piton may be made to serve for both. This pump throws up water equally when the piton-rood is drawn up or when it is forced down, and is most proper for the double-acting steam-engine. It has the advantage of raising twice the quantity of water that any of the other pumps will raise, and with the friction of only one piton; also the valves admit of being made of sufficient size to allow the passage of the water without any unnecessary refittis.

Force-Pump with a solid Plunger.—This was invented by Sir Samuel Morland, and does not differ from the force-pump last described, except in the manner of fitting the piton to the barrel. Instead of the barrel being bored truly cylindrical within and out, and the piton fitted into it so as to slide up and down, and provided with leathers to make a close fitting, the piton is made of a cylindrical form, and very nearly
as large as the hollow barrel into which it descends, but it
does not touch the inside of the barrel. To make the close
fitting, the outside surface of the cylindrical piston, or plunger,
as it is called, is made very true and smooth; and it is sur-
rrounded by a collar of leathers fixed at the top of the barrel,
so that no water can leak out of the barrel between the
plunger and the leather collar; at the same time that the
plunger can freely move up and down through the collars,
and will thereby increase or diminish the capacity of the bar-
rel, to produce the same effect as if the piston fitted close
into the barrel.

The principal circumstance to be attended to in this
pump is the construction of the collar of leathers. To re-
tain these leathers in their places, the top of the barrel must
be made with a flaunch, and pierced with holes to receive
screw-bolts. Upon this flaunch two rings of metal are ap-
plied one over the other, with similar holes; the internal
opening in the lowest ring is exactly the size of the plunger,
and that of the upper one a little larger. Two rings of soft
leather are cut out to correspond with the metal rings, except
that the central holes are rather smaller than the plunger:
to prepare the leather, it is soaked in a mixture of oil and
tallow for some hours. One of these leather rings is laid on
the pump-flaunch, and one of the metal rings placed above
it; the plunger is then thrust down through the leather, which
turns the inner edge of the leather ring downwards; the
other leather ring is then slipped on at the top of the plunger,
and the second metal ring is put over it, and then the whole
are fixed down to the metal ring by this the inner edge of
the last leather ring is turned upwards.

The metal rings and leathers are now fixed on the flaunch
by the screw-bolts; and thus the leathern rings are strongly
compressed between them, and make a close joint with the
top of the barrel; and as the holes through the leathers are
smaller than the plunger, they grasp the plunger so closely
that no preasure can force the water through between them.
The lower metal ring just allows the plunger to pass through
it, but without any play, so that the turned-down edges of
the lower leathern ring cannot come up between the plunger
and the lower metal ring, but are lodged in a conical enlarg-
ment, which is made round the inner edge of the upper
part of the barrel; and in like manner the turned-up edges
of the upper leather are received in the hole of the upper
metal ring, which hole is made larger than the plunger, to
leave a space all round for these edges; it is on these trifling
circumstances that the great tightness of the collar depends.

To prevent the leathers from shrinking by drought, there is
usually a little eilern formed round the head of the pump,
and kept full of water.

This kind of pump is preferable to any other, where the
preasure to be overcome is very considerable. The hydro-
statical preffures are contradicted on this principle. See Press.

Pistons or Buckets for Pumps.—A good piston should be
as tight as possible, and should have as little friction as is
consistent with this indispensible quality. The bucket of
the common fucking-pump, when carefully executed, pos-
tesses these properties in a high degree, and is the model for
other kinds of pump-buckets, or pistons, in which leather
can be employed. This bucket is in the form of a truncated
cone, with a hollow through the centre of it, which is half as
large as the outside, at the largest part; it is generally made
of wood not liable to split, such as elm or beech, but in the
bell kind of pumps is made of metal. The small or upper
end of it is cut away at the sides, so as to open into the
hole through the centre of it, and form an arch, by which it is
fastened to the iron rod or spear of the pump, and within
the arch the valve or clack is situated. The lower end of
the conical part may be covered with a hoop of brads, which
fits the barrel of the pump very exactly; the bucket is also
surrounded with a ring or band of strong leather, fastened
to the wood with nails, and firmly retained by the brads hoop
which is driven down on the barrel from the upper or the
smaller end of the cone, and binds the leather fast on the
wood; but the leather being wider than the brads, the edge
of the leather rises upwards and surrounds the wood: this
part of the leather is made to turn outwards, like a cup or
hollow cone, which, at the upper end, is rather larger than
the barrel, so as to spring against the inside of the bar-
rel when the bucket is put into it. The leather must be of
uniform thickness all round, so as to suffer equal compres-
sion between the wood of the bucket and the working
barrel, but this compression is very slight, because it is the
upper edge of the cup which applies most closely to the
barrel. The seam or joint of the two ends of the band of
leather must be tapered, and made to overlap and lie very
close, without increasing the thickness, but not sewed or
litched together, as that would occasion bumps or inequa-
ilities, which would spoil its tightness; and no harm can
result from the want of fewing, because the two edges will
be fqueezed close together by the compreflion in the
barrel; nor is it by any means necessary that this compref
be great, for it occasions friction, and caufes the leather to
wear through very soon at the edge of the bucket, and it
also wears the infide of the working barrel, which soon
becomes enlarged in that part which is continually paffed over
by the pifton, while the mouth remains of its original dia-
eter, and then it is imposfible to thrust in a pifton which
shall completely fill the worn part. A very moderate pre=
ffure is fufficient for rendering the pump perfectly tight,
because the pressure of the water makes the leather cup
apply itself close to the barrel all round, and even adjust it
to all its inequalities. Suppofe it to touch the barrel in a
ring of an inch broad all round, this is trifide, and the fric-
tion occasioned by it not worth regarding; yet this small
surface is fufficient to make the paffage perfectly impervi-
ous, even by the preffure of a very high column of incum-
 bent water; for let this preffure be ever fo great, the pre-
ffure by which the leather is forced against the infide of the
barrel will always exceed it, because, in addition to the pre-
ffure of the water, the leather will always press against the
barrel by its own elaticity, the top of the cup of leather
being made rather larger than the interior of the barrel.

This method of applying leather piftons is found to be
preferable to any other, because if the leather is pilfed
against the barrel by any other means than the force of the
column of water, the preffure will always be too great or
to little.

Pumps which are to raise hot water cannot be leathered,
because the leather would shrivel up; in this cafe, strong
canvas cloth is sometimes used instead of leather; but as this
will not hold water perfectly, such pumps are generally packed
with hemp, in the fame manner as the pifton of steam
engines.

Pump without Friction.—When the height to which the
water is to be raised is small, a pump may be constructed in
which the pifton does not require to be fitted closely into
the barrel, nor are any leathers required. The barrel of this
pump must be as long as the whole height to which the
water is to be raised, and as much more as the length of
the stroke of the pifton. The pifton is a solid piece of wood,
fixed to the barrel as closely as it can be without actually
touching the inside, and may be either square or round,
but a square trunk and a square beam of wood are best, if
the pump is made of wood. The pifton must be as long as the
barrel,
barrel, so that when it is let down it will occupy the whole interior space of the barrel, except that small space which is left between the inside of the barrel and the plunger, to avoid actual contact. The bottom of the barrel has a valve in it which opens upwards, and a pipe proceeds from the lower part to convey away the water to the reservoir in which it is to be raised by the pump. This pipe is provided with a valve, to prevent the return of any water which has passed through it, but the greatest elevation of the water in the reservoir must not be quite so great as the top of the barrel. When this pump is fixed for work, the lower end of the barrel must be walled in the water of the well at least as much as the whole length of the stroke, so that the lower end of the plunger will never rise above the surface of the water in the well, and upon this circumstance the action of the pump depends; for when the plunger is drawn up, the water flows through the valve in the bottom by its gravity, and fills the space which is left by the drawing up of the plunger; when the plunger descends, it displaces the water out of the barrel and forces it up the side-pipe into the reservoir. It is true that a small portion of water rises in the space between the barrel and the plunger, but this small quantity cannot escape, because the top of the barrel rises higher than the surface of the water in the reservoir.

Dr. Robinson, who we believe first described this pump, observes that it is free from all the difficulties which are experienced in common pumps, from want of being air-tight. Another is, that the quantity of water raised is very nearly equal to the power expended; for if there is any want of accuracy in the work, which occasions a diminution of the quantity of water discharged, it also makes an equal diminution in the force which is necessary for pushing down the plunger. The doctor mentions a machine, consisting of two such pumps, the pistons of which were suspended from the arms of a long beam or lever, the upper side of which was formed into a walk, with a rail on each side. A man floated on one side of the centre of the lever, until the piston of the pump at that end sunk to the bottom of its barrel, and of course the piston of the pump on the opposite side of the centre was drawn up; he then walked slowly up to the other end of the walk upon the beam or lever, the inclination being about twenty-five degrees at first, but gradually diminished as he went along, and passed on the opposite side of the centre of motion, so as to change the load of the beam. By this means he made the piston at the other end go down to the bottom of its barrel, and so on alternately, with the easiest of all exertions, and what a man is most fitted for by his structure. With this machine a feeble old man, weighing 110 pounds, raised 7 cubic feet of water 11 1/2 feet high every minute, and continued working eight or ten hours every day. A stout young man, weighing nearly 135 pounds, raised 83 cubic feet to the same height; and when he carried 30 pounds conveniently slung about him, he raised 94 feet to this height, working ten hours a day, without greatly exhausting himself. This exceeds Defaguliers' maximum of a hoghead of water ten feet high in a minute, in the proportion of 9 to 7 nearly. This pump is limited to very moderate heights, and in such situations it is very effectual.

The mercurial pump is a species of lift-pump, in which mercury is employed to make a close fitting between the piston and the barrel, and thus avoid the friction of leathers, and prevent loss of water. This pump was originally invented by Mr. Joshua Hafkins, and was improved by Defaguliers, who described it in the Philosophical Transactions for 1722, No. 370. p. 5; and he has also given every detail of the construction in his Experimental Philosophy, vol. ii. p. 491.

In this pump the barrel is inverted, that is, it is open at the bottom, like the first lift-pump which we have mentioned; and it has also two pipes communicating with the upper end of the barrel, one to bring up the water from the well, and the other to carry it up to the reservoir: each pipe is provided with its valve, to prevent the return of the water. The barrel must be made of iron, and as thin as is consistent with the strength of the metal. The piston is a cylindrical plug of wood, fitted to the barrel so as to fill it, but not to touch the sides. This piston is fixed perpendicularly in the centre of a hollow cylinder of iron, which is rather larger within than the outside of the pump-barrel, so that an annular space is left all round between the solid piston or plug and the inside of the cylinder, into which space the pump-barrel can enter, and will fill it very nearly. The annular space is then filled with mercury. This compound piece, consisting of the hollow cylinder, with the smaller solid cylinder within it, forms the piston; and to this the power which is to work the pump is applied by means of chains, which suspend it from the short arms, so that if the lever is moved, the piston will rise up and down. When the piston is applied in its place, and the inverted pump-barrel is received into the annular space between the solid and hollow cylinders, the mercury therein will make a close fitting between the solid piston and the inside of the barrel, so as to prevent any water puffing between them; and the ascent and descent of the piston will produce an alternate contraction and dilatation of the internal capacity of the working barrel, in the same manner as a solid piston would do, if it were closely fitted to the inside of the barrel with leather all round.

As the water exerts a pressure on the mercury, to force it out of the annular space in which it is lodged, the depth of the annular space and length of the barrel which descends into the water must be adapted to the height to which the water is intended to be elevated; so that the column of mercury which it will contain, without raising the mercury so high as to run over the edge of the external cylinder, shall always exceed one-thirtieth part of the height to which the water is to be elevated; the weight of mercury being more than thirteen times the weight of an equal quantity of water.

That there may be less mercury used, the pump-barrel should be made of plate-iron, turned on the outside, and bored within; the outer cylinder of the piston should be bored, and the inner one turned; and if the work be well performed, eight or ten pounds of mercury will be sufficient, though the bore of the barrel, or diameter of the column of water which is raised, is four inches. Less than six pounds of mercury would suffice, if there were two barrels, in order to keep a constant stream. This will very much lessen the expense of mercury, which would otherwise be an objection against this pump; and by making the inner and outer cylinder of hard wood, as box, or lignum vitæ, the expense may still be reduced. But if the engine be very large, cast-iron bored will be proper for the outer cylinder, and cast-iron turned on the outside for the inner cylinder or plug, and hammered iron bored and turned for the middle cylinder.

There is an objection, which seems at first to take off the intended advantage of this engine, viz. that instead of the friction of the leather of a piston, when we lift up the piston to make a stroke, the resistance necessary to make the mercury to rise on the outside of the barrel in the outer cylinder of
WATER.

of the piston is at least as great as the friction we avoid. Defagullers says, that resistance is never greater than the weight of a concave cylinder of mercury, whose height is the greatest to which the mercury rises in the said outer cylinder, and the base is the area of the barrel itself. This weight in a pump of 6 inches bore is equal to 57½ pounds, and, therefore, it would appear to be greater than the resistance arising from the friction of a piston. But if it be considered, that in the descent of the piston for sucking, the mercury shifts immediately into the inside of the barrel, rising to the same height therein, and still keeping the same base, the weight of 57½ pounds helps to press down the piston, and facilitates the overcoming of the force of the atmosphere, or suction of the pump; consequently, the weight of the mercury being balanced is no hindrance, whether the pump works with a double or with a single barrel.

There remains only then the hindrance by loss of time, whilst the mercury changes from the outside to the inside of the barrel, at the beginning of any stroke. Defagullers states this to be one-fifty-second part of the stroke, and that he found the bell pumps then in use generally lost near one-fifth of the water that they ought to have given, according to their number of strokes.

Notwithstanding the high terms in which this author and others have spoken of the mercurial pump, it can only be considered as an ingenious suggestion, for the expense of mercury would be too great for the actual application of any such machine in practice; and in respect to friction, it would have a considerable share of resistance in plunging the piston into the mercury, although there would be no actual rubbing of hard substanences together. This resistance would arise in the rapid running of the mercury from the inside of the barrel to the outside, and back again, at the beginning of each stroke.

The machine is exceedingly ingenious and refined, and there is no doubt but that its performance will exceed that of any other pump which raises the water to the same height, because there can be no want of tightness in the piston, and friction is in a great measure avoided. But these advantages are but trifling. The expense would be enormous; for with whatever care the cylinders are made, the interval between the inner and outer cylinders must contain a very great quantity of mercury. The middle cylinder must be made of iron-plate, and without any seam, for mercury disdies every kind of folder. For such reasons, it has never come into use. But although we have professed to describe only the machines in actual use, it would have been unpardonable to have omitted the description of an invention, which is so original and ingenious; and there are some occasions where it may be of use, such as nice experiments for illustrating the theory of hydraulics: it would be the best piston for measuring the pressures of water in pipes, being in fact the same principle as the barometer.

Sett'd pumps are those in which the piston is made to move upon a centre, like a door upon its hinges. The piston is inclosed within a vessel shaped like the sector of a circle, which forms the body of the pump, and which is divided by the piston into two compartments. The piston is fitted, so that it can move backwards and forwards on its centre of motion, without suffering any water to pass by it; and by this motion it will alternately enlarge or contract the capacities of the two compartments, so as to draw in water through pipes and valves properly fitted, and force it out again at other pipes. These kinds of pumps are difficult to construct, and have no advantages over the pumps with straight barrels, except for the engines for extinguishing fire. See that article for a description and figure of Mr. Rowntree's, which is one of the best of this kind.

Rotative Pumps.—As most of the first movers for hydraulic machinery act with a rotative motion, it would be very desirable to have a pump which would at once employ the rotative force to the purpose of raising water. Many schemes have been proposed, and much ingenuity displayed in these inventions; but the whole has been brought to such perfection as to be equal to the pumps with straight barrels. In Ramelli's work, published in 1628, several rotative pumps are described; and Leopold has made a collection of them in his "Theatrum Machinarum Hydraulica," vol. i. They are all upon one common principle, viz. a hollow cylinder or drum closed at both ends; within this another smaller cylinder is inclosed, and the interior cylinder is placed out of the centre of the hollow cylinder, so that the interior cylinder touches the hollow one at one point of the circumference; but at all other points there is a considerable space between the two. The interior cylinder is provided with four or six valves or leaves, which are united to it by hinges, and, when folded close up to the cylinder, will form a smooth and circular circumference; but if the leaves are opened out, they will reach to the interior surface of the hollow cylinder. When the interior cylinder is turned round by a handle applied to the axis, the valves sweep round within the hollow cylinder, and in this motion perform the office of pistons, because they close up to the internal cylinder, in proportion as they approach towards the point where the internal cylinder touches the hollow cylinder; and the same vanes open out again, after they have passed that point. In this way the spaces between the valves form a number of cavities, which alternately expand and contract in their capacity, and in consequence they will draw up water through a pipe which is inserted into the hollow cylinder, and force it out at another pipe, so as to raise up a continual stream.

The machine is sometimes varied, by making the hollow cylinder of an elliptical form; in other cases, the valves, instead of moving upon hinges, are made to slide in straight lines from the centre of the revolving cylinder; but in either case, the action is the same. The common defect of all these rotatory pumps is, that it is very difficult to pack them so as to be tight, and they have more friction than any other kind of pump.

The centrifugal pump, invented by Mr. Ertkine, may be called a rotative pump, but it is on a different principle from all other pumps. A perpendicular pipe has another joined to it, in form of the letter T; the lower end of this pipe being immered in water, and the whole filled with water, it is turned round on the perpendicular stem as an axis; the water contained in the horizontal arms will, by its centrifugal force, fly out, and draw a constant stream of water up through the perpendicular pipe. See Centrifugal Pump.

Spiral pump, or Zurich machine, is a hollow drum or cylinder turning on a horizontal axis, and partly plunged in a cistern of water, like a very large grindstone. The interior space of this cylinder or drum is formed into a spiral canal, by a plate coined up within it, like the main-spring of a watch in its box, only that the spirals are situated at a given distance from each other, so as to form a spiral passage of uniform width. (See fig. 11. Plate Water-Works.) This spiral partition is well joined to the two circular ends of the cylinder, and no water can escape between them. The inner
WATER.

inner end or central part of the spiral passage communicates with the axis, which is hollow at one end, and communicates with the vertical pipe which is to convey the water to the elevated reservoir. The outermost turn of the spiral passage begins to widen at about three-fourths of a circumference from the open end, and this gradual enlargement continues for nearly a semicircle; this part being called the horn. The passage then widens suddenly in form of a scoop or shovel. The cylinder is so supported, that this scoop may, in the course of a rotation, dip several inches into the water, and take up a certain quantity of water before it emerges again. This quantity is sufficient to fill the enlarged part called the horn, and is also nearly equal in capacity to one turn of the outermost uniform spiral. The vertical pipe is connected with the axis by a turning joint, so as to admit of the rotation of the axis, at the same time that it will not allow of the escape of any water.

When this cylinder is turned round by a handle applied to the extremity of the axis, a portion of water which the scoop takes up at every turn, will continually advance in the spiral, until it arrives at the centre; it will then pass through the hollow in the end of the axle, and will rise upwards in the vertical pipe; and in the intervals between the periods when the scoop dips into the water, the horn will become filled with air, and the succeeding portion of water which is taken in will carry the air before it, so that the water rises in the vertical pipe mixed with air. See SCREW.

Dr. Robinson, in his account of this machine, recommends the riving pipe to be of small bore; for if the pipe is so large as to allow the air to escape freely upwards through the water, the machine will raise the water to a certain height, proportioned to the number of turns of the spiral, and to their diameter; but if the pipe be narrow, so that the air cannot rise freely, it will rive in the pipe almost as slowly as the water. By this circumstance, the water mixed with the air becomes of a less specific gravity, as it were, and can be raised to a much greater height than it could be raised by the mere preassure of the columns of water and air in the different turns of the spiral. This is effected with hardly any augmentation of the power, but if the air, after being compressed, is suffered to escape, all the force exerted to compress it will be lost. The entrance into the riving pipe should be no wider than the half part of the spiral; and it would be advisable to divide it into four channels by a thin partition, and then to make the riving pipe very wide, and to put into it a number of slender rods, which would divide it into several slender channels, that would serve completely to entangle the air among the water. This procedure will greatly increase the height to which the heterogeneous column may be carried.

Another Form of the Spiral Pump.—When the main pipe is very high, the former construction will require either an enormous diameter of the drum, or many spiral turns of a very narrow pipe. In such cases, it will be much better to make the spiral in the form of a cork-screw, than of a flat form like a watch-spring; or, the pipe which forms the spiral may be wrapped round the fruiting of a cone.

We regret that we have had no opportunity of making experiments upon a machine of this kind, as its principles of action, though treated of by many authors, are not described in a satisfactory manner in any works which we have read.

The chain pump is an effectual means of raising water, and with the advantage of a continuous motion. It is generally made with a square or round barrel, placed in a perpendicular position. The chain is furnished with several pittons of the same figure as the barrel, which are fixed at small distances afunder upon the links of the chain. The ends of the chain are united together, and it is extended between two wheels, one fixed at the upper end of the barrel, and the other at the lower end; but sometimes only the wheel at the top is used. These wheels have forks fixed on the circumference, which are so contrived as to receive one half of each of the flat pittons in the intervals between the forks, whilst the forks take hold of the links of the chain, and draw them up, when the wheel is turned round by means of a handle applied to the axis. The pittons on the chain are made accurately to fill the section of the barrel, at the lower part near the water, and also for a few feet upwards; but above this, the barrel is made larger, so that the pittons rise upright; indeed, the upper part of the barrel is only to contain the water which is brought up by the pittons, and may, therefore, be square, or of any other figure. The lower end of the barrel is impermeated in water, and the chain being caused to circulate by turning the wheel, each piston, as it enters into the lower or bored part of the barrel, will bring up water before it in the barrel; which water will rise in the upper part of the barrel, till it runs over the top; and as the pittons succeed each other in a regular succession, they produce a constant stream. Chain pumps are chiefly used in ships, where they are worked by the force of men turning winches. (See PUMP.) In other situations they are moved by horses, and sometimes by the impulse of a stream of water. They are so contrived, that by the continual folding in of the pittons, when they enter into the bottom of the barrel, stones, dirt, or whatever comes in the way, may be cleared off. On this account they are often used to drain ponds and fewers, or to remove foul water, when no other pump could be employed.

The greatest disadvantage in the chain pump is the friction of the chain, and of the pittons, which is greater than in other pumps; because several pittons are moving in the barrel at the same time, and also because the pittons do not admit of the application of the cup-leathers, which we have described. The edges of the cups would fold up when they enter into the barrel, and get between the edge of the pitton and the barrel. The pittons are, therefore, made with a thick piece of leather, which is placed between two round plates, which form the pitton or faucer, as it is called; the leather is cut round to the size of the barrel, so that the edge of the leather may be applied to the inside of the barrel. In this way, its tightness must depend wholly upon the force with which the leather is squeezed into the barrel, and it occasions great friction to make the pittons sufficiently tight.

Another variety of the chain pump is an endless rope, with stuffed cushions fastened upon it at regular intervals. By means of two wheels or drums, the rope is made to circulate, and the cushions are drawn up in succession through the barrel, and each one carries some water before it.

The chain pump is found to raise a greater quantity of water to the same height, when the barrel is placed in an inclined position, than when vertical. M. Behidor recommends the barrel to be placed at an angle of 24 degrees with the horizon, and the distance between the pittons to be equal to their diameter. The reason of this advantage is, that an inclined pump acts with less friction, because the pittons need not be so exactly fitted, but they will, by their weight alone, apply closely to the bottom or lowest side of the inclined barrel; whereas the pittons of the vertical pump must exactly fill the barrel, or the water will leak down from one to the next in a constant stream.

Bellows-Pump.—A pair of leathern bellows may be employed as a pump, if a suction-pipe is applied to the lower valve, and another pipe to the nozzle, with a valve to prevent
prevent the water returning into the bellows after it has been driven out by closing the bellows. This kind of pump has been frequently proposed, and the advantages of dispensing with barrels and pistons loudly infused upon; but the refissistance of the leather in folding, and the loss of water by leakage, and above all the want of durability, will always prevent the adoption of such pumps.

The Pump with a Diaphragm of Leather, which does not slide in the Barrel.—This is very nearly allied to the bellows-pump. The bell form for constructing it is fully described in our article Ship's Pump, where the invention is attributed to Benjamin Martin; but we find the same thing was long before applied by Meffrs. Goffet and De la Deuille, in France. (See Belidor's Arch. Hydraulique, vol. ii. p. 120.) This is a good pump, but is not durable, because the constant strain on the leather will cause it to crack.

Sucking-Pump, which gives out a continual Stream.—Mr. Smeaton applied the following simple and effectual expedient to make a single sucking-pump deliver the water equally in the descent of the bucket as in its ascent. The pump-rod was enlarged, by surrounding it with a cylinder of wood at the part where it rote above the surface of the water contained in the cistern at the top of the pump. This cylinder of wood was of such diameter, that its section was equal to half the area of the pump-barrel at the place where the bucket was worked. When the bucket was drawn up, and raised water into the cistern at top of the pump, the wood cylinder, which was attached to the pump-rod, rose up out of the water in the cistern, and thereby made place in the cistern for one-half of the water which was brought up by the bucket, and in consequence only one-half of the water ran out at the spout of the cistern; but when the bucket moved downwards, in order to fetch another stroke, this cylinder of wood displaced from the cistern half as much water as the pump brought up in the former instance, and consequently an equal quantity of water was given out at the spout in either case.

If the pump is worked by the force of a man working a simple lever, then he will make the down-stroke of the bucket in less time than the up-stroke, and in this case the area of the cylinder should be made less than half the area of the barrel of the pump. It must be observed, that this contrivance is only a remedy for the unequal efflux of water from the sucking-pump, and that the power required to work the pump is still left unequal in the up-stroke and down-stroke, because it is only in raising up the bucket that the water is drawn from the well below; and that water which runs out at the spout when the bucket descends, is drawn from the cistern at the top of the pump, and not from the well. When the pump is worked by a man with a lever, this inequality of the resistance is advantageous, because a man can exert his force most conveniently when he depresses the end of the lever to draw up the bucket; also, in a single-acting steam-engine, the principal power is exerted to draw up the bucket.

In machines worked by wind, water, or horses, the moving force is uniform, and the resistance must, by some means, be made uniform also, or the machine will move by sudden starts. A sufficient weight may be applied to the opposite end of the lever to counterbalance one-half of the force necessary to draw up the bucket; this weight will tend to diminish the force of drawing up the bucket, and when the bucket descends, and the machine would otherwise have nothing to do, it will have to raise up the weight ready to aid it in the succeeding stroke. Or a fly-wheel may be applied; but a still better method is to employ two pumps to act alternately, by which means the resistance is continual, and the efflux of water also. When two sucking-pumps are employed, they may be combined together, by making them both draw from a common suction-pipe, and both may be made to lift the water into the same cistern. Or two or three force-pumps may be combined together, as is described in the article Pump, in order to produce a continuous stream.

Air-Vessel for equalising the Discharge of Water from Pumps.—This is the most perfect contrivance for effecting that purpose. It is a close vessel of any figure, which will contain air, and is made to communicate with the pipe which conveys the water away from the pump. This communication must be made at the lower part of the air-vessel, so that the water will have free ingress and egress from it. The air in this vessel will be compressed into a smaller space, in proportion to the column of water which the pump has to raise; and by its elasticity endeavouring continually to regain its former place, it will act as a spring to equalize all sudden motions of the water through the pipe; for in any pump which acts by a barrel and piston, the water will be propelled by slarts; and even if two or three barrels are combined together so as to produce a continual efflux of water, such efflux will not be perfectly equal during all the periods of the motion.

The evil of this may appear trifling and so it would be merely with respect to the discharge of the water; but it must be considered that the mass of water contained in a long pipe is very great, and that it requires a very considerable force to put this mass in motion with that velocity with which it must flow through the pipe. Now if the operation of a pump is by slarts, the mass of water in the main-pipe will remain at rest, pressing on the valve during the time that the piston is withdrawn from the bottom of the working barrel. In this case, the force necessary to put the water in motion must be expended at every stroke, because if the column comes to rest only for an instant, it must be put in motion again before the operation can be resumed; this is a heavy additional load upon the first mover, and has another more serious evil in flattening the pipe and all parts of the machinery; because the column of water in the pipe, after it flows, runs back for a small space until the valve shuts; and it makes just as great a concussion or shock when its motion is suddenly stopped by the flattening of the valve, as any other solid body would do which was of the same weight, and moved with the same velocity. In large steam-engines, the shock occasioned by the flattening of the valve is exceedingly violent, unless an air-vessel is applied. In that case, if the pump urges the water with a sudden motion, the air in the vessel will yield, and admit the water into the vessel in far less time than the whole column of water could be urged into motion; but as the air will become compressed by more force than the column of water in the pipe, the elasticity of the air will force the water from the vessel and up the pipe with a regular motion, and this will continue until the air has regained so much space that its elasticity is only just sufficient to balance the column of water in the pipe.

The air-vessel should be placed as near the pump as possible, that it may produce an equal motion of the water in the whole length of the pipe. The air-vessel is of considerable advantage when a column of water of great length is to be raised by a single-acting pump. If the piston of the pump at one end of the pipe is put at once into motion, even with a moderate velocity, the strain on the pipe would be very great before the column of water could be put in motion. But the air-vessel tends to make the motion along the main-pipe less fatiguing, and therefore diminishes those strains which would really take place in the pipe. It acts like
like the springs of a travelling carriage, whose joints are incomparably less than those of a cart, and by this means really enables a given force to propel a greater quantity of water in the same time.

The stream produced by the assistance of an air-vessel is almost perfectly equitable, and as much water runs out during the returning of the piston as during its active stroke; but it must not be imagined that it therefore doubles the quantity of water. No more water can run out than what is sent forwards by the piston during its effective stroke. The continued stream is produced only by retaining part of this water in the air-vessel during the stroke of the piston, and by providing a propelling force to act during the piston's return; but it cannot enable the moving force of the piston to produce an increased effect: for the compression which is produced in the air-vessel, more than what is necessary for merely balancing the quiescent column of water, reacts on the piston to retch its compression just as much as the addition of a column of water would do, the height of such column being sufficient to produce the required velocity of the efflux.

**Machines for working Pumps.**—The best method of working pumps from a first mover which acts with a rotatory motion, is by means of cranks; and if two or more pumps are to be actuated by the same machine, the cranks for them should be placed at regular intervals round the centre, so as to produce a continual action.

It has been observed, in our article Steam-Engine, that the reciprocating motion obtained by a crank is very unequal, even when the rotatory motion of the crank is quite uniform. This renders the motion of the piston in the barrel of the pump irregular, for at the top and bottom of the barrel the motion of the piston is very slow, but when the piston is at the middle of the barrel the piston moves quickly. This property is a great advantage in working pumps, because it puts the column of water in motion with a less sudden shock; but it has been very generally mistaken and considered as a defect, and many ingenious contrivances have been propounded, by means of racks and pinions, to give an uniform motion to the piston-rods of pumps. These have never succeeded in practice, and have always been laid aside.

The attempts of mechanicians to correct this unequal motion of the piston-rod are misplaced; for if it could be done it would greatly injure the performance of the pump. As this is a favourite speculation, and new attempts to perfect it are constantly making, we think it right to shew the reason of their failure.

Suppose the first mover to move uniformly with a rotatory motion, and that the machinery is so constructed, that the piston-rod will be moved up and down with a regular motion, or that the velocity of the piston shall be at all times the same, whether it is at the top or bottom, or in the middle of its course. In this case, at every reciprocation, the column of water in the main pipe must be suddenly urged into motion from a state of rest, and the machine could not perform one stroke, if the velocity of the first mover did not slacken a little, or if the different parts of the machine did not yield by bending or compression. These strains would be so sudden and violent, that no strength of materials could withstand the violence of the shocks at every reciprocation of the motion. This would be chiefly experienced in great works which are put in motion by a water-wheel, or some other equal power, exerted on a large mass of matter, of which the machine consists. The water-wheel, being of great weight, moves with steadiness or uniformity; and when an additional resistance is opposed to it by the beginning of a new stroke of the piston, its quantity of motion is but little affected by this addition, and it proceeds with very little loss of motion. The machine must therefore yield a little by bending and compression, or it must break to pieces, which is the common event.

A crank is free from this inconvenience, because it accelerates the piston gradually, and brings it gradually to rest, while the water-wheel moves round with almost perfect uniformity. It has been stated as an inconvenience of this flow motion of the piston at the beginning of its stroke, that the valves do not shut with rapidity, so that some water gets back through them; but this is a mistake, because the valves always fall by their own weight as soon as the water ceases to flow upwards through them. Now when the piston begins to move with its flow motion towards the end of its stroke, leaves water is caused to flow through the valves, and in consequence they close gradually, and will be fully shut by the time that the piston becomes motionless, and before it begins to return. This is shewn in the large machines, such as that of London-bridge, where the pumps are worked by cranks, and the valves close imperceptibly; but in a steam-engine of the same power, the shock occasioned by the shutting of the valves is exceedingly violent. In short, by a judicious application of the crank and a fly-wheel, or an air-vessel, and by employing two or three barrels to the pump, the evils of the reciprocating motion of pumps may be completely remedied, and on this account we consider, that if a rotatory pump could be brought to perfection, it would have no superiority over an accurate pump with a straight barrel.

**Mr. Snecaton's proportions for a two-horse pump machine.**

The Pump Machine at Blenheim, which was erected by Mr. Aldersca for the duke of Marlborough, is thus described by Mr. Ferroum in his lectures. The water-wheel is undershot, and is turned by the fall of the water running down an inclined plane, and striking the floats of the wheel. The extremity of the pivot or gudgeon is formed into any number of cranks; for instance, there is, three at each end of the axis, more or less, according to the force of the fall of water, and the height to which the water is intended to be raised by the engine. As the water-wheel turns round, these cranks move as many levers up and down, by the iron connecting-rods. These levers alternately raise and depress the pistons of the forcing-pumps by other iron rods, which are attached to the opposite ends of the levers, and as one is raised the opposite piston is depressed. Pipes go from all these pumps, to convey the water which they draw up (to a small height) into a close cistern or box, from which
devoted to the water-machines, that is, five on the London
dike, and one on the Southwark side.

Mr. Smeaton's great Engine at the fifth Arch of London
Bridge.—This machine is represented in perspective, in
Plate II. Water-works, Machines for raising Water.
The view being taken from beneath the arch of the bridge, B B
represents the flaring of the fourth pier of the bridge,
composed of a vast body of piles driven into the bed of the
river, and the interlaced filled up with chalk and gravel.
Upon the heads of these piles, a set of horizontal beams
are laid in the manner of joists, and all is made level by chalk
and gravel.

The fifth pier CC is made in the same manner. The
water-wheel F F G G is made of such a breadth as to fill
the space between the two flarlings as exactly as possible,
without touching; and the bearings for the gudgeons of
its axis are supported upon head-rocks E E, which rest
upon the flarlings. The water-wheel has four circular
rings F F F F, each sustained by six arms mortised into the
axis; each ring has twenty-four flarlings mortised into it, and
to these are nailed the float-boards f f, upon which the water
acts to turn the wheel round.

Upon each end of the main axis is fixed a large wooden
wheel H H, round which cast-iron rings or cogs are fixed
in segments. These cog-wheels turn two trundles, which
give motion to the forcing-pumps, which are fixed in number,
viz: one three-barrelled pump on each side of the water-
wheel; but only one of the engines or triple pumps is shewn
in the figure, for as the other is exactly the same, it is suf-
icient to describe one. The axis on which the trundle I
is fixed is of cast-iron; it is connected with a triple crank, one
arm of which is marked b, and two others are hidden behind
the frame: g h i are strong iron rods, joined to the cranks
at their lower ends, and to the ends of the great levers or
regulators K L M at the upper ends.

The regulators are poled on centres in the middle of
their length, and have arches k l m at the other ends, which
are sunk from the centres of motion, upon which arches
the chains are laid, to give motion to the piston-rods of the
pumps N.

By the motion of the water striking the float-boards, the
water-wheel is made to revolve on its axis, and the large cog-
wheel H with it. This turns the trundle I and the triple
cranks b c, which, being arranged round the axis at equal in-
tervals, elevate and depref the crank-rods g h i and regu-
ators K L M succeffively, and give to the pump-rods and
piston a vertical motion.

The joints of the crank-rods g h i are made to screw to-
gether round the crank-neck with brass between; by this
means they work very pleasantly, and when worn can be
screwed up tight again that they may have no shake.
The crank-rods are each made in two lengths, each of which has
a flange at the end, and they join at n in the middle of the
rod: the flanges are held together by three screws, so as
they may be taken apart occasionally without difficulty,
when the pump-forceers are to be drawn out of the barrels
to new leather them.

The joints at the end of the beam or levers are made
with brasses, and screws to adjust them; and so are the cen-
tres or fulcrums of the levers.

The levers or regulators are admirably well designed to
be strong, with but little timber; they are formed of two
pieces of timber, between which the cast-iron axis on which
they turn are placed; and then the ends of these pieces are
bent to touch, and are kept together by hoops and screw-
bolts, so as to make close joints. At the ends, several small
square pieces of wood are interposed crofs ways in the

WATER.

joints at the ends of the lever, being let into both timbers;
by these, when they are firmly bound together, the two
pieces of timber are prevented from sliding end ways upon
each other, so as they form an excellent trusfs-beam, for it
cannot bend or yield without stretching one timber and
compreffing the other.

The pump-rods are attached to the arches at the ends of
the beams by four iron chains each, as is shewn in fi g. 2.
The rod has a cross-piece p fixed on the top of it, to which
the two outside chains are attached, and the lower ends of
the fame chains are fastened at the lower end of the arch.

These chains act to pull down the piston-rods; the other
two chains which return or raise the rods are fastened to
the top of the arch, and to the rods at the lower ends, as shewn
in the figure.

The pumps are forcing-pumps, and raise the water when
the pistons are depressed: the lower piece of the triple
pump is a square iron-pipe or trunk, screwed fast down
upon the ground-sells of the engine-frame; this is called the
fution-piece: it has a flange at each end, to one of which a
lid is screwed, and the other joins it to the fuction-pipe R,
which brings up the water from the river. On the top of
the trunk, the three barrels N are screwed, each having
a valve in the joint, which allows water to enter into the
barrel, but prevents its return. From the bottom part of
each barrel proceeds a crooked pipe q, which communicates
with another square trunk S, called the forcing-piece, hav-
ing valves at the joint, to prevent any water from getting
back into the barrels. On the top of the trunk over each valve
is a round hole, over which a lid is screwed, but can be re-
moved to clean or repair the valves when necessafy. Similar
lids are screwed on over openings into the fution-trunk, at
the back towards the cranks. At the ends of the forcing-
trunk S are flanches, one of which receives a lid like the
lower trunk, and the other flanch joins to the pipe z, which
conveys the water away from the pumps.

The pistons or buckets of the pumps are solid, that is,
without valves in them; and their action is as follows:

When the piston of any of the barrels is drawn up, it
makes a vacuum in that barrel, and the pressure of the at-
mosphere on the surface of the water from which the fution-
pipe R draws, raises the valve at the bottom of that barrel,
and fills it with water. At the descent of the piston, the
lower valve shuts, and the water contained in the barrel can
find no passage but through the valve in the forcing-trunk
S; and when the piston is drawn up again this valve clofes,
and the lower one opens to give a fresh supply of water to
the barrel. By the position of the triple cranks, it always
happens, that one or other of the barrels is forcing the
water into the force-pipes; and as the strokes of the other
set of pumps at the other end of the water-wheel are con-
trolled to be intermediate or alternating to these, a conflant
succession is kept up.

The main-pipe z is continued to the shore, to convey the
water into the streets. A wooden cifter T is placed over
the pumps to hold water, and keep a conflant supply of it
above the pistons to prevent leakage. The whole engine
is surrounded by a strong timber fence, which guards it from
the injuries it might receive from velfs or floating ice,
skirting it at high water, when the water rises above the
level of the flarlings nearly to the axis of the water-wheel.
On the tops of these pipes, a large slage is built, to serve as
a road from the shore to the engine, and the underfide of it
supports the main-pipes, which convey the water aforhe.
There are also other slages in different parts of the machine,
to support workmen when repairing it; these prevent the
whole engine from being seen from the bridge at one view, and
for
for this reason they are omitted in the drawing, which is in some degree imaginary, as it represents the engine detached.

This machine is more simple than the preceding, as it performs more work by fix pumps of ten inches bore and \( \frac{4}{5} \) feet stroke than the other by sixteen pumps of seven inches bore and \( \frac{2}{5} \) feet stroke, and therefore with much less loss of power by friction; and as the cranks only work in one direction, they work much more pleasantly than when there are pumps at both ends of each lever, because in that case the strain on the cranks, connecting-rods, and the fulcrums of the levers, in fact on all the joints, is alternately in different directions, and if there is any shake or looseness in the joints, it produces jerks and irregularities.

By using three barrels and triple cranks, the supply of water, forced into the main-pipe, is more equable than when four are used, though not perfectly so. The perpendicular motion produced by the arches and chains, is a great advantage in making the barrels wear equally.

In order to enable this engine to work as long as possible in each tide, and after the velocity of the motive water is abated, it is contrived to adjust the resistance to the diminished power. This is done in the most simple manner by a small cock and pipe in the chamber of each pump-barrel; just above the suction-valve from this cock, a rod of communication rises up to the flag to turn it by, and this cock being opened will admit air into the barrel when the piston is drawn up, so that the water of the river will not be drawn up into that barrel; and in consequence, it will become inactive, and the wheel will be relieved from the load of working it. In this way, the load of the engine is adapted to the power of the tide at its different periods; but when all the three barrels are thus relieved by opening the air-cocks, the motion of that engine becomes a undefies load friction of the pistons and movements; and to relieve this, the shaft or axis of connection between the axis of the trundle and the triple crank, is provided with the means of disuniting or uniting the bars while in motion, so that one engine will stand still while the other is at work.

The principal dimensions of this machine are as follow:—

The water-wheel is thirty-two feet diameter, measuring to the outside of the float-boards; the length of the float-boards fifteen feet and a half, and their breadth four feet and a half; the number of float-boards twenty-four. At each end of the axis is fixed a cog-wheel, fourteen feet diameter, with eighty cogs: each of these turns a trundle of twenty-three flats, fixed on the axis of the cranks, which are triple; that is, three cranks are formed side by side on the same axis, and bent in different directions, so as to produce a continual action. Each crank actuates a lever or working beam eighteen feet long, which is poised on a fulcrum in the middle, and gives motion to the pump-rods by an arch-head and iron chains. The pump-barrels are ten inches diameter, and the pistons make strokes of four feet and a half long; they are forcing-pumps, and three barrels are combined together, to throw the water into one main pipe, which conveys the water into the town; the highest elevation to which the water is ever raised is two and twenty feet. The cranks, beams, and pumps, at each side of the wheel, are exactly similar, so that the wheel actuates fix pumps.

This machine was erected, under Mr. Smeaton's directions, in 1767, and worked constantly for fifty years, when the timber-work becoming decayed, it was rebuilt in 1817, with cast-iron instead of wood, and has been lately let to work. The principal proportions of Mr. Smeaton's design have been preferred, but the great levers have been suppuflated, and the cranks are placed over the face pumps as the former.

**Mr. Smeaton's Pump Machine at Stratford Water-works.**

This is so like the last, that we shall only give the principal dimensions, as an example of the bell proportions for a machine with a break-wheel, the last being underfoot. The water-wheel was sixteen feet diameter and eight feet wide; upon its axis was a cog-wheel of eleven feet and a half diameter, with seventy-eight cogs, which turned a cog-wheel of five feet one inch diameter, with thirty-five cogs. This was fixed upon the axis of the cranks, which were three in number, and by means of three beams gave motion to three forcing-pumps nine inches diameter and two feet and a half length of stroke, lift of the water 84 feet. In addition to the pair of cog-wheels just mentioned, there was another pair, of different proportions, fixed close to the fides of the others, and by a simple contrivance either pair could be brought into action, and the other pair would then be disengaged. The second wheel, which was fixed in the axis of the water-wheel, was nine feet eight inches diameter, with fify-six cogs, and the wheel on the axis of the cranks which belonged to it had forty-seven cogs. The intention of these two lets of wheels was to adapt the water-wheel to work equally well when it was flooded and impeded in its motion, as when the water was low; for when the quick motion was in use, the cranks made 15.6 revolutions per minute, whilst the water-wheel made seven revolutions. But when the slow motion was in use, the cranks would make 15.2 revolutions per minute, whilst the water-wheel made eleven. This machine is seven horses' power.

**The Pump Machine at Marly.**

This is situated between Marly and the village La Chaussée. In that place the river Seine is penned up partly by the machine and partly by a dam, which keeps up the water; but in order that the navigation may not be interrupted, a canal has been cut, two leagues above Marly, for the passage of boats and barges. There has been erected, about thirty-five fathoms from the machine, a contrivance, called an ice-breaker, to prevent floating pieces of ice or timber, which come down the stream, from damaging the machine, and the better to secure the pen-flocks, and the channels in which the water-wheels move. There is a grate of timber to stop whatever may come through the ice-breaker.

The water is raised to its destined height by the force of fourteen underfoot water-wheels, which work the pumps at three different stages: first, on set of pumps to lift the water from the river, to a weir placed up the hill two hundred and thirteen yards from the river, and at the elevation of a hundred and sixty English feet above the level of the Seine. The power of the wheels is conveyed also to this place by chains, in order to work a second set of pumps, which force the water to the second weir, a hundred and eighty-six feet higher, and therefore three hundred and forty-six feet above the river, and fix hundred and ninety yards distant. At this spot is a third set of pumps, to throw up the water from the latter to the summit of a tower a hundred and eighty-nine feet higher, and at a distance of one thousand three hundred and thirty yards from the river up the mountain. The whole elevation is rather more than five hundred and thirty-five feet above the river. From the cistern in the tower the water is conveyed, by an immense aqueduct, to the gardens of Marly.

The breadth of the machine comprehends fourteen water-four,
WATER.

courses, each flut by a sluice or pen-flock, which can be raised and deprefled by racks, and in each of these courses an underfoot wheel is placed. The fourteen wheels are difposed in three lines across the river. In the firft line, which is up the stream, there are seven wheels, in the second line six, and only one in the third.

The wheels are thirty feet diameter, and five feet wide, and they are all nearly the fame as follow: the ends of the axle of each wheel go beyond their bearing pieces, and are bent into cranks, which make levers of two feet; the crank which is towards the mountain gives motion to a beam or lever, which carries four pinions or forcers at each end, to work in the barrels of as many forcing-pumps, which as the wheel works alternately fuck up the water of the river, and drive it up into the firit ciftern. The other crank at the opposite end of the axle gives motion to the chains, which go up the hill, to work the pumps in the two elevated cifterns.

Each of the fix wheels on the firft line is contructed in this manner, to give motion by one of its cranks to an engine, confifting of eight forcing-pumps combined togethcr. The engine is actuated by a lever or beam, from each end of which a square piece of wood is fupplefed, that carries and directs four pinions of forcing-pumps; the beam of the engine is put in motion from the crank of the wheel by a beam or leader, which is connected with the crank of the wheel at one end, and with one arm of a regulator or bent lever, whilst the other arm of this regulator is united by another leader to the extremity of the beam of the engine, which beam is thus made to vibrate up and down and work the pumps.

Of the fix wheels we have just mentioned, there are five which, by their opposite cranks, give motion to the pumps in the elevated ciftern of the firft lift. This is effected by means of one vertical beam or lever, and two horizontal levers, which are bent, and actuate the chains that communicate the motion; the three levers are only to change the direction of the motion of the crank into a proper direction to go up the hill. The fixth wheel, which is the firft towards the dam, gives motion to a long chain that goes up the hill to work the pumps of the upper ciftern. The seventh wheel of the firft line is exclusively applied to move a chain, which goes to the firit ciftern, by both its cranks.

The fix wheels of the second line are like the five wheels in the firft row, i.e. one of the cranks of each works an engine of eight pumps, and the other a chain that goes to the upper ciftern.

Laftly, the single water-wheel, which is on the third line by each of its cranks, works an engine of eight forcing-pumps fixed in the river, and of itself supplies one conduit-pipe of eight inches and a half bore.

There are then eight engines in the river, and reckoning all the chains which go up the hill, they are thirteen in number, including the chains that come from the fixth and seventhe wheels of the firft line: these thirteen chains ascend the hill all together, and are fuppended at regular intervals of twenty feet by levers, to bear them up from touching the ground, which by moving on their centre admit of the working of the chains. Each chain is double, that is, there is a confecnd chain, which is connected to the opposite ends of the fuppended levers, and each chain serves to draw the other chain back again after it has made its froke. Five of these double chains are employed to actuate levers, which work thirty inverted lift-pumps situated in a ciftern at the firft lift, and which drive the water through two pipes of eight and a half inches bore up to the upper ciftern. The other eight double chains go straight on to the upper ciftern.

The seven chains of the wheels of the firft line, in going along, work also eight fucking-pumps, placed a little below the ciftern of the firft lift, because in that place the water of a confiderable spring is brought by an aqueduct, and these fame chains take up that water a second time by forty-nine pumps, which are situated in a separate ciftern, at the firft lift, on a level with the firit ciftern, and force it into the upper refervoir, through two conduit-pipes of eight and a half inches diameter, and three others of fix and a half inches diameter.

The water raised by the seventy-nine pumps in these two cifterns at the firft lift, difcharges itself into a great refervoir at the second lift, and then by two conduit-pipes of a foot diameter each, it runs into refervoirs of communication, and is diftributed into the feveral wells or little pump-cifterns of the upper ciftern, which all together contain eighty-two inverted lift-pumps; they force the water through fix conduit-pipes of eight inches and a half diameter up into the ciftern, in the tower which answers to the aqueduct. These eighty-two lift-pumps are worked by the eight great chains before mentioned, that go straight to the upper ciftern, without moving any pumps by the way; and the fame chains work fixteen fucking-pumps behind the upper ciftern, to bring back into the refervoir of the fame ciftern the water which leaks out of the fix iron pipes that go to the tower.

To fum up all the pumps of this intricate machine:

1. The eight engines in the river contain fixty-four pumps, which fuck and force the water 160 feet up five iron pipes of eight and a half inches bore, and 213 yards long, up to the firft lift.

2. The two cifterns at the firft lift contain seventy-nine lifting-pumps, which raife the water 186 feet, through four pipes of eight and a half inches bore, and three pipes of fix and a half bore, and 477 yards up to the fcond lift.

3. The cifterns at the second lift contain eighty-two lifting-pumps, which raife the water 189 feet through fix pipes of eight and a half inches bore, and 1535 yards diftance. To this must be added eight fucking-pumps in the river called feeders, which raife water into the cifterns at the top of the forcing-pumps, to keep water in the pumps, and prevent leakage; also the eight others which are below the midway ciftern; and laftly, the fixteen fucking-pumps, which we mentioned as placed behind the upper ciftern, fo that the machine has in all 577 pumps.

The bafin of the tower, which receives the water raife by the river, and supplies the aqueduct, is 1530 yards diftant from the river, and 553 feet above the level: the water having run along a stone aqueduct, which is raife by thirty-fix arches, is separated into different conduits, which lead it to immense refervoirs at Marly, and formerly conveyed it alfo to Versailles and Trianon.

Such is the mechanism of the machine of Marly. Its mean produce in Belidor's time was from 3000 to 4000 English cubic feet of water per hour: he fays mean pro-duce, becaufe under certain favourable circumstances it has formerly raife more than 8434 cubic feet per hour. But during inundations, or when the Seine is frozen, when the water is very low, or when any repairs are making, the machine stops in a great meafure, if not entirely.

The annual expences of the machine have been fixled formerly at 3000 ftling, or 48 per day, including the salaries of thofe who fuperintend it, and the wages of the workmen employed, together with repairs, necifary articles, &c. This makes about one farthing for every eleven cubic
cubic feet. Or, taking into the account the interest of 333,000, the original expense of erection, which is five times as great as the annual expenses, 11 cubic feet, which is 67 gallons, will cost three half-pence, or at the rate of a farthing for 11 gallons.

This is the account of it given by Belidor in his second volume.

Rannequin, the inventor, was a ingenious practical mechanic, but no mathematician or philosopher. In several positions, the moving forces act unnecessarily obliquely, which occasions a great loss of power, and renders the machine less efficient. A great proportion of the whole moving power of some of the water-wheels is employed in giving a reciprocating motion to the fets of rods and chains, which extend from the wheels to the cisterns, nearly two-fifths of a mile distant, where they work a set of pumps.

As this machine is continually quoted as the most powerful of all machines, we will compare its power with some of the large steam-engines in England. The quantity of water is \( \frac{84,944}{60} = 141 \) cubic feet per minute \( \times 535 \) feet, the height to which it is raised, \( = 75649 \) cubic feet per minute lifted one foot high. Divide this by 528 cubic feet, which is the quantity that can be lifted one foot per minute, by what is called a horse-power in steam-engines \( = 143 \) horse-power; but as the machine acts by 14 water-wheels, each one will be scarcely 10\( \frac{1}{3} \) horse-power. The horse-power is one-third greater than the average of horses, and we therefore estimate that 215 horses working together, would do as much work as this machine ever did, or 15 horses to each wheel; but as the horses could only work eight hours per day, three fets must be kept to continue constantly.

M. Montgolfier informs us that the supply of water to the wheels is 138,000 cubic feet per minute, and the fall is 43 feet; this gives a power 8\( \frac{1}{4} \) times as great as the effect produced. Montgolfier found 22\( \frac{1}{4} \) times when he tried it.

The whole work is now in a very ruinous state, and many projects have been formed for a restoration of the machine on better principles.

It is probable Rannequin thought his moving force would not be sufficient to raise the water to the height of 535 feet at once; and this is agreeable to the practice of more modern engineers.

If the machinery was constructed in cast iron, in the same manner as steam-engines are now made, the force of one crank would be more than sufficient to raise a cylinder of water of that altitude, and above eight inches in diameter, without any complication; but the pipes would require very great strength. This is proved by a machine that has been lately erected at Marly, in place of one of the old water-wheels.

Even according to the original construction, the water might be raised in one jet to the second reservoir. This appears from two experiments, one made in 1738, and the other in 1775. In the first, M. Camus endeavoured to make the water rise in one jet to the tower; his attempt was not attended with success, but he made the water rise to the foot of the tower, which is considerably higher than the second reservoir. During this experiment the machine was so much strained, that it was found necessary to secure some parts of it with chains.

The object of the second trial, made in 1775, was to raise the water once to the second lift, 346 feet. It did ascend thither at different times, and in great plenty, but the pipes were exceedingly strained at the bottom, so that several of them burst, and it was necessary to suspend and recommence the experiment several times. This arose from a fault which might easily have been remedied; viz. from the age of the tubes and their want of strength; therefore it results from this trial, that the chains which proceed from the river to the first lift might be suppletted, together with the second; which is perhaps is all that is to be expected without a complete change in the machinery.

Rules for calculating the Dimensions of Pumps.—The quantity of water delivered by any pump will be in the joint proportion of the surface or base of the piston and its velocity; for this measures the capacity of that part of the working barrel which the piston paffles through; and the same is true of sector pumps, or rotary pumps: but as pumps with straight cylindrical barrels are the only kind in general use, it will be sufficient to give the rule for calculating the content of a cylinder, which is simply to multiply the area of the base by the length; thus, take the diameter of the barrel in inches, and the length of the stroke in feet.

Square the diameter in inches, and divide by \( 183.3 \): multiply this by the length of the stroke in feet, and it gives the content of the cylinder in cubic feet.

Example.—How many cubic feet of water will be raised in an hour by a pump \( 8\frac{1}{4} \) inches diameter, and \( 3\frac{1}{4} \) feet stroke, which makes 18 strokes per minute?

Diameter \( 8.5 \) inches \( \times 8.5 = 72.25 \) circular inches: divide it by \( 183.3 \), which is the number of circular inches in a square foot, and it gives \( 0.394 \) square feet for the area of the barrel \( \times 3.5 \) feet in length \( = 1.797 \) cubic feet; the content of the barrel \( \times 18 \) strokes per minute \( = 24.822 \) cubic feet of water raised per minute \( \times 60 \) minutes \( = 1489 \) cubic feet per hour.

If it is required to know the quantity which a pump will raise in ale gallons, it is obtained by the following rule: take the diameter of the barrel in inches, and the length of the stroke in feet.

Square the diameter in inches; multiply by the length in feet, and divide by 30.

This should give the content of the barrel in ale gallons of \( 282 \) cubic inches each; but the rule is not perfectly correct, for it assumes the gallon to be \( 282 \frac{1}{4} \).

Example of the same Pump as above.—The square of the diameter is \( 72.25 \) \( \times 3.5 \) feet in length \( = 252.875 \) \( + 30 = 8.429 \) ale gallons for the content of the barrel. The true measure in this case is \( 8.45 \) gallons, which is very near.

To find the force requisite to work any pump, take the diameter of the barrel in inches, and the perpendicular height of the column of water in feet.

Square the diameter in inches; multiply by \( 34 \) decimal, and multiply by the height of the column in feet.

This gives the force in pounds avoirdupois. It is usual to add one-fifth to this weight, on account of friction and refinance.

Example.—Suppose the above pump lifts the water 64 feet in the whole, what force will it take to draw up the piston?

The square of the diameter is \( 72.25 \) \( \times 34 \) lbs. = \( 24.55 \) lbs., which is the weight of one foot high of the column \( \times 64 \) feet \( = 1572 \) lbs., the weight of the whole column. Add \( \frac{1}{5} \) of this, viz. \( 314.4 \) lbs. = 1886 lbs. the weight required to draw up the piston and give it a proper velocity.

In constructing pumps, care must be taken to avoid all unnecessary contractions in the valves or pipes which convey the water. If the water-way is too small, the water will not be
be greatly refilled in its passage through such contrac-
tions; and this is called by the workmen wire-drawing the
water.

The velocity of the water in the conduit-pipe, and in its
passage through every valve, will be greater or less than the
velocity of the pifton, in the same proportion that the area of
the pifton or working barrel is greater or less than the area
of the passage of the valve. For whatever quantity of
water passes through any section of the working barrel in a
second, the same quantity must go through any one of the
passages; this enables us to modify the velocity of the water
as we please, and we can increase it to any degree at the
place of delivery, by diminishing the aperture through
which it passes, provided we apply sufficient force to the
pifton. This is the case in the engine for extinguishing
fires; but no such increase of velocity must be suffered in
pumps which are required to raise the greatest quantity
of water with a given power; because the power required
to force the water with a great velocity is very considera-
tble, and the velocity so obtained adds nothing to the mechanical
effect which is produced. The resistance arises from a two-
fold cause; viz. the friction of the water against the sides
of the passage, and still more from the resistance which
water opposes to any sudden change of figure; for though
water is a perfect fluid, and will readily accommodate itself
to any change of figure by its own gravity, yet, it requires
some time to make such change; and if we force it to
change its figure in less time than it naturally would, it re-
quires mechanical power to do so, just the same as to
compress a mass of clay, or other inelastic and non-elastic
body.

In practice, the velocity with which the piston of the
pump moves, determines the size of the smallest passage
through which the water can pass without unnecessary re-
sistance. Few pumps move with a greater velocity than 80
or 100 feet per minute; and we think the area of the narrow-
est passages and pipes should bear such a proportion to
the area of the barrel, that the water will never be urged
with a greater velocity than three feet per second, or 180
feet per minute, if the power required to move the pump is
an object. In general, this will be accomplished by making
the area of the smallest opening equal to one and a half
area of the barrel; or if the diameter of the barrel is divided
into 10 parts, the diameter of the least opening should be 7
of those parts. If the pump moves slower, then the passages
may bear a smaller proportion. The pumps which have solid
pistons are preferable, because the valves can be made of any size
which is required; but when a valve is made in the pifton,
its size is necessarily limited to less than we have recom-
manded.

**Effimate of the Strength of Men to raise Water.**—Various
authors have stated the mean force of a man to widely dif-
ferten, that the fluid is perplexed which to choose. The
following table contains several of these statements, which
we have reduced to one common denomination; viz. the
number of pounds avoidupois, or the number of cubic feet of water which a man can raise in one minute to the
height of one foot.

<table>
<thead>
<tr>
<th>Authors.</th>
<th>Pounds Avoidupois raised one Foot per Minute.</th>
<th>Cubic Feet of Water raised one Foot per Minute.</th>
<th>Duration of the Work.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hachette</td>
<td>1343</td>
<td>21.5</td>
<td>Working 10 hours per day.</td>
</tr>
<tr>
<td>Amontons</td>
<td>1530</td>
<td>24.8</td>
<td>Working during 8 hours in 24.</td>
</tr>
<tr>
<td>Euler</td>
<td>3000</td>
<td>48</td>
<td>For 8 hours.</td>
</tr>
<tr>
<td>Smeaton</td>
<td>3608</td>
<td>58.7</td>
<td>For 10 hours.</td>
</tr>
</tbody>
</table>
| Bernouilli | 3750                                         | 60                                           | A feeble old man, working 8 or 10 hours per day, a pump without fric-
| Schulze  | 2859                                        | 61.7                                          | tion.                |
| Defaguilier | 4114                                        | 66.3                                          | A young man weighing 135 lbs.: 10 hours per day. |
| Emerfon  | 5500                                        | 70.5                                          |                     |
| Dr. Robinson | 6300                                      | 100.8                                         |                     |
| Average of all these | 6648                                          | 16.4                                          |                     |
| True standard | 4098                                         | 65.5                                          |                     |

It is not difficult to account for these great differences,
when we consider how the muscular force varies in different
individuals, and also the power of enduring fatigue. The
only means of ascertaining the mean force of a man is to take
the sum total of the work executed by a number of men
acting for a great length of time. This was repeatedly
done by Mr. Smeaton, on a very large scale, and with so
very little variation, that we can very confidently recom-
mend engineers to calculate a man's force at 62 cubic feet,
or 3750 lbs., raised one foot per minute; as this is just one
 cubic foot per second, it will easily be fixed in the memory.
Defaguilier's estimate of one hoghead raised ten feet high per
minute, is very frequently used, and is 5500 lbs. raised one
foot per minute, but it is too great for a mean; and Defagui-
lier himself called it the maximum, which no machine can
exceed.

When a machine is to be turned by the force of a man
turning a winch or handle, the handle ought not to be
longer than from 12 to 16 inches; nor should it be calcu-
lated to make more than 30 turns per minute; and when
moving with this velocity, it should not require a greater
force than 15 lbs. pressure upon the handle; or a man will
not be able to move it without greater fatigue than he can
endure for a day's work. If the handle is required to move
flower,
flower, for instance 30 turns per minute, then the load may be increased in proportion; viz. to 256 lbs., and this will be less fatiguing.

<table>
<thead>
<tr>
<th>Authors,</th>
<th>Pounds Avoided per minute.</th>
<th>Cubic Feet of Water raised one Foot per minute.</th>
<th>Duration of the Work.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hachette's estimate that a horse is equal to 7 men</td>
<td>9406</td>
<td>130.5</td>
<td>Working 9 hours per day.</td>
</tr>
<tr>
<td>Fenwick</td>
<td>13200</td>
<td>211.2</td>
<td>Working 9 hours per day, light work.</td>
</tr>
<tr>
<td>Gregory</td>
<td>18480</td>
<td>295.6</td>
<td>Working 8 hours per day.</td>
</tr>
<tr>
<td>More</td>
<td>21120</td>
<td>337.9</td>
<td>Working 8 hours per day.</td>
</tr>
<tr>
<td>Watt</td>
<td>20000</td>
<td>320.0</td>
<td>Working 8 hours per day.</td>
</tr>
<tr>
<td>Smeaton's 2 horse machine, with an Archimedes' screw</td>
<td>20104</td>
<td>321.6</td>
<td>Working 8 hours per day, nearly equal to 6 men.</td>
</tr>
<tr>
<td>Smeaton's 4 horse machine to work at flash-wheel</td>
<td>20418</td>
<td>326.7</td>
<td>Working 8 hours per day.</td>
</tr>
<tr>
<td>Smeaton's standard</td>
<td>22916</td>
<td>366.6</td>
<td>Working 8 hours per day.</td>
</tr>
<tr>
<td>Defaguilers' estimate that a horse is equal to 5 men</td>
<td>27500</td>
<td>440.0</td>
<td>Working 8 hours per day.</td>
</tr>
<tr>
<td>Smeaton's experiment on drawing coals with 2 horses</td>
<td>27720</td>
<td>443.0</td>
<td>Working 8 hours per day.</td>
</tr>
<tr>
<td>Meffrs. Boulton and Watt's horse-power in steam-engines</td>
<td>32000</td>
<td>512.0</td>
<td>Working 8 hours per day.</td>
</tr>
<tr>
<td></td>
<td>33000</td>
<td>528.0</td>
<td>Working 8 hours per day.</td>
</tr>
<tr>
<td>True standard</td>
<td>22000</td>
<td>352</td>
<td>Working 8 hours per day.</td>
</tr>
</tbody>
</table>

In this, as in the former instance, we feel inclined to give the preference to Mr. Smeaton's estimate, both from his superior experience and accuracy, and also because by his MS. papers, we are informed of the particulars of his experiments. He found, from examining the accounts of a colliery, that each horse drew 27720 pounds one foot per minute; but as they could only continue to work at that rate for 4 1/2 hours per day, Mr. Smeaton fixed his standard at 250 hogheads per hour raised ten feet, which is equal to 22,916 pounds, raised one foot high. Still we find in two of his machines, of which we have already given the particulars, the performance fell rather short; we have, therefore, chosen to recommend 352 cubic feet of water, or 23,000 pounds per minute raised one foot high, as a standard for a horse's force, when he works 8 hours per day, and moves with a velocity of 2 1/2 miles per hour. This is settled by universal consent as the most proper pace for a horse to walk; and he will in that case draw just 100 pounds, which is an easy number to remember.

The estimate of Defaguiers we consider as the maximum of a horse's power; for the horse-power of Meffrs. Boulton and Watt is only used as a measure of the force of their steam-engines. See that article.

In applying horses to work machines, the circular tract in which they walk should be as large as possible, that the horses may turn round in the circle with little inconvenience. Few cafes will admit of a walk of more than 30 feet diameter; and in proportion as this is diminished, the horse loses some of his power. No horse-walk should be made of less than 20 feet diameter, if he is required to act with any considerable force. When this size cannot be obtained, we are of opinion that the horse would work to a greater advantage by walking within a large perpendicular wheel, like those wheels used for canals.

The machine which is to raise the water should be so connected with the principal wheel which the horse turns, that it will move with the proper velocity, when the horse-wheel turns at the rate above specified. The velocity proper for most machines is mentioned in the description of each.

Water-wheels applied to raise Water.—The circumference of a water-wheel will work to the greatest advantage, when it moves with a velocity of from 3 to 4 feet per second, or from 180 to 240 feet per minute. A very proper velocity for a water-wheel is to make it the same as the horses, by the above table; and we have, therefore, added the velocities for smaller diameters.
WATER.

<table>
<thead>
<tr>
<th>Diameter.</th>
<th>Circumference.</th>
<th>Turns per Minute.</th>
</tr>
</thead>
<tbody>
<tr>
<td>18 feet.</td>
<td>56.4 feet.</td>
<td>3.9</td>
</tr>
<tr>
<td>16</td>
<td>50</td>
<td>4.4</td>
</tr>
<tr>
<td>14</td>
<td>44</td>
<td>5</td>
</tr>
<tr>
<td>12</td>
<td>37.5</td>
<td>5.86</td>
</tr>
<tr>
<td>10</td>
<td>31.4</td>
<td>7</td>
</tr>
</tbody>
</table>

Few machines, with pumps worked by a water-wheel, will raise more water to a given height in any time, than amounts to one-third the mechanical effect of the quantity of water employed to work it; that is, considering the differences of the heights to which the water is raised, and the height of the fall, and reducing them both to an equality, the quantity of water raised will never exceed half of the quantity which falls. The other half is lost in friction and leakage, and in overcoming the inertie of the parts of the machine.

Pressure engines are those machines which give motion to the piston of a pump, by the force of a column of water acting in a cylinder or barrel, similar to that of the pump. (See the article Pressure-Engine.) It was omitted in that article, that M. Behidor invented a machine, which may be considered as the first which was perfect, and was indeed the model for that made by Mr. Smeaton. See Architecture Hydraulique, vol. ii. p. 240.

M. Baillet made observations upon several machines of this kind in the mines of Hungary, from which it appears that the mechanical effect produced, is only four-tenths of the mechanical effect of the first power.

<table>
<thead>
<tr>
<th>Height of the Fall of Water to work the Machine.</th>
<th>Diameter of the Pistons.</th>
<th>Quantity of Water expended in 24 Hours.</th>
<th>Height to which the Water is raised.</th>
<th>Quantity of Water raised in 24 Hours.</th>
<th>Ratio of the Effort, and the Cause.</th>
</tr>
</thead>
<tbody>
<tr>
<td>French Metres.</td>
<td>Metres.</td>
<td>Cubic Metres.</td>
<td>Metres.</td>
<td>Cubic Metres.</td>
<td>0.45</td>
</tr>
<tr>
<td>85.757</td>
<td>0.352</td>
<td>1900.328</td>
<td>89.656</td>
<td>817.036</td>
<td>0.46</td>
</tr>
<tr>
<td>89.656</td>
<td>0.325</td>
<td>2467.965</td>
<td>214.39</td>
<td>479.879</td>
<td>0.33</td>
</tr>
<tr>
<td>79.910</td>
<td>do.</td>
<td>685.55</td>
<td>40.777</td>
<td>394.185</td>
<td>0.36</td>
</tr>
<tr>
<td>79.910</td>
<td>do.</td>
<td>582.711</td>
<td>28.585</td>
<td>589.666</td>
<td>0.40</td>
</tr>
<tr>
<td>89.656</td>
<td>do.</td>
<td>2467.965</td>
<td>66.267</td>
<td>1336.815</td>
<td>0.4 mean.</td>
</tr>
</tbody>
</table>

The French metre is equal to 3.281 English feet, and the cubic metre is 35.3198 cubic feet English.

Power of the largest Steam-Engines to raise Water.—The most powerful machine in existence is the steam-engine, on Mr. Watt's principle, called Stoddart's engine, at the United Mine in Cornwall. Three other engines of equal dimensions are employed to drain the mine, but only this one is loaded so as to exert its utmost force. The steam cylinder is 63 inches diameter, and acts double; that is, it operates to raise water equally in the ascent or descent of the piston. The weight of water in the pumps is 82,000 pounds, and with this load it makes 62½ double strokes per minute of 72 feet each; or, it gives to the load 100⅔ feet motion per minute.

Multiply 82,000 pounds by 100⅔ feet, and it gives 8,261,500 pounds per minute lifted one foot high: divide this by 33,000 pounds, which is called the horse-power, and it gives 250½ horse-power for the acting force of the engine. Again, divide 8,261,500 pounds by 62½ pounds, the weight of a cubic foot of water, and we find this engine is capable of raising 132,184 cubic feet of water per minute to a height of one foot. This is not one of the best engines with respect to fuel, and it burns 31½ pounds of coal to raise this quantity.

The whole power employed to drain the United Mine is as follows:

<table>
<thead>
<tr>
<th>Horse-Power.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stoddart's engine, 63 inch cylinder, double acting</td>
</tr>
<tr>
<td>William's engine, 65 inch cylinder, do.</td>
</tr>
<tr>
<td>Sim's engine, 63 inch cylinder, do.</td>
</tr>
<tr>
<td>Poldorzy's engine, 63 inch cylinder, do.</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

Here we have a single machine of nearly double the power of the famous machine at Marly, which is in fact composed of fourteen machines, working in concert for a common object; and so do the four engines in the mine, which amount to 83½ horse-power, without reckoning the engines employed to draw up the ore.

The engines at several other mines in Cornwall are of immense power. We will state two.

The mine called Wheat Alfred has four engines: a 63 inch double engine, which is lightly loaded, and only exerts 80 horse-power; a single acting engine of 66 inch, and 60 horse-power; and two others of 64 and 60 inch, equal to 51 and 54 horse-power—in the whole, 245 horse-power to drain one mine.

The Dolcoath mine has three engines: a double engine of 63 inch cylinder, and 132 horse-power; a single engine of 63 inch, and 45 horse-power; and a smaller single engine of 20 horse-power—in all, 197 horse-power to drain the mine.

It will be observed above, that the power of the different engines is not in proportion to the dimensions of the cylinders: this is because the pressure upon each square inch of the piston varies in different engines from 7 to 20 pounds. But custom has established, that certain sizes of cylinders will be equal to a certain number of horses' power, as is shown by the following table.

The steam in the boiler is supposed to be kept within the limits of from 2 to 4 lbs. pressure on each square inch more than the atmosphere; and in that case the cylinders of the diameters marked in the Table will have very nearly the powers assigned to them.

A Table
A Table of the Dimensions of the Cylinders of Mr. Watt's Steam-Engines, either Double or Single, shewing their different Powers, either to raise Water by Pumps, or to turn Machinery by Cranks and Fly-Wheels.

<table>
<thead>
<tr>
<th>Nominal Horse-Power</th>
<th>Dimensions of the Piston</th>
<th>Effective Pressure or Load on the Piston</th>
<th>Velocity of the Motion with which the Load is raised</th>
<th>Mechanical Effect expressed by the Weight which can be raised in a Minute to a Height of one Foot</th>
<th>Consumption of Coals in an Hour in Pounds Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Diameter in Inches.</td>
<td>Area in square Inches.</td>
<td>Number of square Inches for each Horse-Power.</td>
<td>Length of the Stroke in Feet.</td>
<td>Single Engine.</td>
</tr>
<tr>
<td>1 1/2</td>
<td>6.0</td>
<td>28</td>
<td>28.0</td>
<td>1.5</td>
<td>20.7</td>
</tr>
<tr>
<td>2</td>
<td>8.3</td>
<td>54</td>
<td>27.4</td>
<td>2</td>
<td>15.6</td>
</tr>
<tr>
<td>4</td>
<td>11.6</td>
<td>106</td>
<td>26.5</td>
<td>2</td>
<td>13.8</td>
</tr>
<tr>
<td>6</td>
<td>13.9</td>
<td>152</td>
<td>25.4</td>
<td>3</td>
<td>12.2</td>
</tr>
<tr>
<td>8</td>
<td>15.9</td>
<td>199</td>
<td>24.9</td>
<td>3</td>
<td>10.5</td>
</tr>
<tr>
<td>10</td>
<td>17.7</td>
<td>245</td>
<td>24.5</td>
<td>4</td>
<td>5.8</td>
</tr>
<tr>
<td>12</td>
<td>19.2</td>
<td>288</td>
<td>24.0</td>
<td>4</td>
<td>11.7</td>
</tr>
<tr>
<td>14</td>
<td>20.6</td>
<td>332</td>
<td>23.7</td>
<td>4</td>
<td>11.3</td>
</tr>
<tr>
<td>16</td>
<td>21.7</td>
<td>373</td>
<td>23.3</td>
<td>4</td>
<td>10.5</td>
</tr>
<tr>
<td>18</td>
<td>23.0</td>
<td>412</td>
<td>22.9</td>
<td>4</td>
<td>9.8</td>
</tr>
<tr>
<td>20</td>
<td>24.0</td>
<td>452</td>
<td>22.6</td>
<td>5</td>
<td>8.5</td>
</tr>
<tr>
<td>22</td>
<td>25.1</td>
<td>493</td>
<td>22.4</td>
<td>5</td>
<td>8.7</td>
</tr>
<tr>
<td>24</td>
<td>26.1</td>
<td>532</td>
<td>22.2</td>
<td>5</td>
<td>8.5</td>
</tr>
<tr>
<td>26</td>
<td>26.9</td>
<td>569</td>
<td>21.9</td>
<td>5</td>
<td>8.5</td>
</tr>
<tr>
<td>28</td>
<td>27.8</td>
<td>605</td>
<td>21.6</td>
<td>5</td>
<td>8.5</td>
</tr>
<tr>
<td>30</td>
<td>28.7</td>
<td>645</td>
<td>21.5</td>
<td>6</td>
<td>8.5</td>
</tr>
<tr>
<td>32</td>
<td>29.5</td>
<td>682</td>
<td>21.3</td>
<td>6</td>
<td>8.5</td>
</tr>
<tr>
<td>34</td>
<td>30.3</td>
<td>721</td>
<td>21.2</td>
<td>6</td>
<td>8.5</td>
</tr>
<tr>
<td>36</td>
<td>31.8</td>
<td>765</td>
<td>21.0</td>
<td>7</td>
<td>8.5</td>
</tr>
<tr>
<td>38</td>
<td>31.8</td>
<td>794</td>
<td>20.9</td>
<td>7</td>
<td>8.5</td>
</tr>
<tr>
<td>40</td>
<td>32.6</td>
<td>832</td>
<td>20.8</td>
<td>7</td>
<td>8.5</td>
</tr>
<tr>
<td>42</td>
<td>33.3</td>
<td>869</td>
<td>20.7</td>
<td>7</td>
<td>8.5</td>
</tr>
<tr>
<td>44</td>
<td>34.1</td>
<td>896</td>
<td>20.6</td>
<td>7</td>
<td>8.5</td>
</tr>
<tr>
<td>46</td>
<td>34.7</td>
<td>943</td>
<td>20.5</td>
<td>7</td>
<td>8.5</td>
</tr>
<tr>
<td>48</td>
<td>35.3</td>
<td>979</td>
<td>20.4</td>
<td>7</td>
<td>8.5</td>
</tr>
<tr>
<td>50</td>
<td>35.6</td>
<td>1010</td>
<td>20.4</td>
<td>7</td>
<td>8.5</td>
</tr>
<tr>
<td>52</td>
<td>36.6</td>
<td>1055</td>
<td>20.3</td>
<td>7</td>
<td>8.5</td>
</tr>
<tr>
<td>54</td>
<td>37.3</td>
<td>1091</td>
<td>20.3</td>
<td>7</td>
<td>8.5</td>
</tr>
<tr>
<td>56</td>
<td>38.3</td>
<td>1136</td>
<td>20.3</td>
<td>7</td>
<td>8.5</td>
</tr>
<tr>
<td>58</td>
<td>39.8</td>
<td>1172</td>
<td>20.2</td>
<td>7</td>
<td>8.5</td>
</tr>
</tbody>
</table>

Cubic Feet of Water: 15840
Pounds Avoirdupois: 999000

Double Engine: 660000
Single Engine: 750000

Total: 1319000

WATER.
### Table

#### Water Consumption

<table>
<thead>
<tr>
<th>Engine Type</th>
<th>Single Engine</th>
<th>Double Engine</th>
<th>Total</th>
<th>By Each Engine</th>
<th>Per Minute</th>
<th>Per Hour</th>
<th>Per Foot</th>
<th>Per Inch</th>
<th>Per Ton</th>
<th>Per Horses</th>
<th>Per Horse Power</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Mechanical Effect

- **Effect on Cylinders, lbs.**
- **Transmission, lbs.**
- **Coordination, lbs.**
- **Transmission, lbs.**
- **Total, lbs.**

#### Velocity of the Motion

- **Velocity of the Motion, lbs.**
- **Velocity of the Motion, lbs.**
- **Velocity of the Motion, lbs.**

#### Length of the Stroke

- **Length of the Stroke, lbs.**
- **Length of the Stroke, lbs.**
- **Length of the Stroke, lbs.**

#### Number of Strokes

- **Number of Strokes, lbs.**
- **Number of Strokes, lbs.**
- **Number of Strokes, lbs.**

#### Load on the Piston

- **Load on the Piston, lbs.**
- **Load on the Piston, lbs.**
- **Load on the Piston, lbs.**

#### Diameter and Area

- **Diameter and Area, lbs.**
- **Diameter and Area, lbs.**
- **Diameter and Area, lbs.**

#### Horse Power

- **Horse Power, lbs.**
- **Horse Power, lbs.**
- **Horse Power, lbs.**

#### Table Continued

- **Nominal Horse Power, lbs.**
- **Nominal Horse Power, lbs.**
- **Nominal Horse Power, lbs.**

---

#### Note

- **Note:** Further details about the table's content can be provided as needed.
This Table is formed from observations of a great number of engines of different powers, and making the intermediate sizes to correspond to the same law of increase. Thus, a twenty-horse engine is always made with a cylinder of 24 inches diameter, which is allowing 22.6 square inches of the piston's surface for each horse-power; but larger engines have a less allowance; an eighty-horse engine has 19.8 square inches to each horse-power, and small engines have a much greater allowance; a ten-horse engine having 24\(\frac{1}{2}\), and a one-horse, 28 square inches. This difference is to compensate for the numerous disadvantages which always attend small machines.

The proper length of the stroke for different engines is not at all settled. Mr. Watt's first engines were made much longer than this Table, but of late years they have been made shorter, and without any adequate reason which we can perceive; for it must be an advantage to a machine to make as few reciprocations as is consistent with a practicable length of cylinder. These differences in the length of stroke do not affect the calculation of powers, because if the length of the stroke be altered, the number per minute is also changed, and the velocity of the piston is the same; at least it will be always nearly the same as the Table for those engines which work a crank and fly-wheel. But it must be observed that these engines move with a greater celerity than the engines for pumping water, because it is necessary to accumulate a considerable velocity in the fly-wheel, or it must be immensly heavy if the piston was to move so slowly as the pumping engine generally does.

It is usual with engine-makers to calculate the velocity of the pistons of engines at 220 feet per minute; but we have rarely found them to come up to this in practice, and have therefore calculated them at 170. In the Table, the pressure upon each square inch of the surface of the fly-piston is in proportion to the velocities there marked; and if the velocities are found less than the Table, as is the case with engines for pumping, then the load upon each inch of the piston must be increased in proportion, or else the power of the engine will be different, although the cylinder remains the same.

For instance, the engine at the Birmingham canal, mentioned in the article Steam-Engine, had a twenty-inch cylinder; and being a single engine, should, by our Table, be rather more than seven horses power. How does this agree? The weight raised per hour to one foot high was calculated, in the article Steam-Engine, at 13,061,805 lbs.; which divided by 60 gives 232,697 lbs. per minute: divide this by 33,000, the horse-power, and we have a seven-horse power; so far it agrees with the Table. But the pressure on each square inch of the piston was 11.7 lbs., and the Table says the pressure should be 7.1 lbs. This difference is reconciled by the differences of the velocities; for the piston of the Birmingham engine moved 63\(\frac{1}{4}\) feet per minute, and the velocity in our Table for a single engine is 98 feet: now as 11.7 is to 7.1, so is 98 feet to 59\(\frac{1}{2}\) feet, instead of 63\(\frac{1}{4}\); the difference is very small, and may be thus accounted for. The Birmingham engine, although seven horses power, had only a twenty-inch cylinder, yet, according to our Table, it should be 20.6; its piston therefore required to move rather quicker, in order to make an equal produce. Thus, the area of a twenty-inch cylinder is 314 square inches; and of a cylinder 20.6 diameter, it is 332 square inches: now as 314 square inches is to 332 square inches, so is 59\(\frac{1}{2}\) feet per minute to 63 feet per minute, instead of 63\(\frac{1}{4}\), which the engine actually moved.

The allowance for fuel in this Table is as small as it will ever be found to be in actual practice; the consumption of fuel is not in direct proportion to the power of the engine, because small engines lose more heat, and have more friction in proportion than large ones, and the reciprocations of the motion are more frequent. We have taken the effect of the twenty-horse engine at twenty millions of pounds of fuel per minute, raise one foot with each bushel of coal weighing 84 lbs.; this makes the consumption of such an engine very near two bushels per hour; an eight-horse burns one bushel. We have also taken the performance of the engine of 100 horses at 50 millions, and made all the intermediate sizes by a regular law of increase; the result agrees so well with several engines which we have observed, that we considered the Table as very correct. The quantities of coal are the smallest; scarcely any engines will do with less fuel when they are working with their full load; but many engines will require more. Engines will be constantly found which are of the dimensions marked in our Table, and are called so many horse-power, although they are working with either a greater or lesser power than the Table expresses; in such cases, allowance of fuel must be altered in proportion.

We have now gone through the description of those machines for raising water which are actuated by the mechanical force of animals, or water of stream acting externally by means of levers and other connecting mechanism; but there are some machines in which a current or a column of water is made to operate within close vessels, and raise water to a considerable height: these are the Chremnitz fountain, the syphon interruptus, and the hydraulic ram. These are most admirable machines, particularly the last, because they are so simple, and having scarcely any moving parts, are not liable to decay and injury; and they do not waste the motive power in unnecessary friction and resistance.

The original beam-engines of the marquis of Worcelter and Savery, which are all of this class, are fully described under the article Steam-Engine. The weight of fuel in these engines is so great, that they fail very far below other engines. We have mentioned the engine made by Mr. Kier, which by a calculation will be found to raise only 2\(\frac{1}{2}\) millions of pounds of water one foot high with each bushel of coal, and the power of the engine is 25 horses. An engine of the same kind, of five horses power, which Mr. Smeaton calculated raised 3\(\frac{1}{2}\) millions, and this is perhaps the utmost of this kind of engines. Another engine of 2\(\frac{1}{2}\) horse-power, raised 5\(\frac{1}{2}\) millions. The belt engine on Newcomen's principle will raise 10 millions; Mr. Watt's 50 millions; and Mr. Woolf's 50 millions. From this statement, it is clear that the expense of fuel in Savery's engines is so great as to counterbalance any advantages arising from their simplicity.

The Chremnitz Machine.—In this a column of water, descending from an elevated reservoir, is made to rise up another column of water from a considerable depth, and air is introduced as the medium for communicating the preffure of the motive column to that column which is to be raised. This machine is not a new invention; its principle is fully described in the Italian book, "Le Machine," by Branca of Rome, 1629. A machine at Chremnitz, in Hungary, is so celebrated as to have given a name to this invention from its size, and the most extraordinary formation of ice and snow by the working of it, besides that it is the only one of the kind which had been applied to large works. An account was given to the Royal Academy at Paris by their correspondent M. Jars, which is inlerted in their memoirs for the year 1768; and Dr. Wolfe has also described it. The machine was executed by father Hell, a professor of astronomy at Vienna, in the year 1755; it is used to raise the water in a shaft named Amalthe, in the mines at Schremnitz, or Chremnitz, in Hungary; fig. 14. Plate Wa-
ter-works, is a sketch of this machine, in which the pipes are not drawn in the proportion of their lengths, but are contractated to the space of the design. O is a wooden trough, placed in the middle of the mountain, 143 feet above the place, K, where the water drains off; this water is conveyed from the mines above it, and the fall of the water from this reservoir works the machine. There is also another trough higher up the mountain, viz. 260 feet above the place of delivery K, into which rain-water is conveyed for the purpose of working the machine with 260 feet fall, when a supply can be obtained therefrom; but when this supply fails, the machine is worked by the cistern O with 143 feet fall. T is an iron-pipe defending from the reservoir, to convey the water to an air-vessel of copper, A, placed at the foot of the mountain near the place of delivery. The water from the reservoir O, or from the more elevated reservoir, flows through the defending pipe T, whenever the cock H is opened: the pipe T defends very nearly to the bottom of the vessel A, A, as shown by the dotted lines X, with the intention that the air included in the vessel shall be comprised when the water enters, and forced through the tube L M into a lower vessel, B, which is similar to A, but only of half the capacity; it is placed at the bottom of the lower mine, which is to be drained at 10.4 feet below the delivery K, and vessel A; this lower vessel receives the waters collected in this mine from the trough D, through the pipe Q and cock C, and by the force of the comprised air introduced into B by the pipe M from the upper vessel; the water contained in B is expelled through the pipe S, which defends to the bottom of the vessel B, and is discharged at F.

The wooden trough D is the termination of a trough or channel from another engine, which raises the water from a yet greater depth; K is a pipe with a cock for discharging the water out of the vessel A, when the operation is over, in order to fill it again with air ready to repeat it, for which purpose the small pipe F is likewise opened to admit air; the cock L transmits and discharges air from the upper vessel A into the lower vessel, through the pipe M. The little pipe E, and its turncock, must be opened to let out the air from the vessel B, and it must remain open whilst B is filling, by the water from the trough D, through the pipe C, O, and it is at the orifice of the little pipe E that snow and ice are generated. A valve is placed at the lower ends of the pipe F S, to prevent the water from escaping out of the pipe F S, after it has been raised, and whilst the vessel B is filling with fresh water.

The operation is performed thus: two men are placed at the vessels A and B to open and shut the cocks; suppose all the cocks shut, and the reservoir O, at 143 feet high, is always full; the pipe T H is also full as far as the cock H; the reservoir D is kept constantly full of water from the mine, which is to be drained by raising the water from D to F, 104 feet; for this purpose, it must first be admitted into the vessel B; the cock C is therefore opened, and the water flows into B, the air being at the same time suffered to escape from that vessel by opening the cock E. The vessel B is known to be full by the emission of water at E, at which instant both the vessels C and E are to be closed. The machine is now prepared for the operation, which is begun by opening the cocks H and L; the defending water from the reservoir O enters the vessel A, and compresses the included air till its elastic force becomes equal to the pressure of the column of water D F, and then the air defends through the pipe M, and enters the lower vessel B, where it presses on the surface of the water contained in the vessel, and forces that water to ascend through S to F, which opens into the adit, through which the water is discharged from the mine. This water being raised, the lower vessel B is become filled with condensed air in place of the water, and the upper vessel A is become filled with water in place of the air. The cocks H and L are then shut, and K and I are opened; the cock K suffers the water contained in A to flow off, and I accelerates the discharge, by admitting the external air into the vessel A; and both these cocks are closed again as soon as the evacuation of the upper vessel is completed. During this last operation another man below opens the cock E, by which the condensed air included in the vessel B fuses with great force through E; he then opens C, and the water from D again fills the vessel B, as at first; this being done, he closes C and E.

The apparatus is now charged again ready for action, and by opening H and L, the above operation will be repeated; viz. the contents of B will be forced up to F, and thus the engine may be kept continually at work as long as the two reservoirs O at the top, and D at the bottom, are kept supplied.

The dimensions of the principal parts, as given by Father HELL, are as follow, in Hungarian measure:

- The diameter of the upper vessel A 32 ½ inches; its height 66 inches; the thickness of the copper ½ inches.
- The lower reservoir O 143 feet above H.
- The upper vessel F S, 143 feet long, 3½ inches bore.
- The air-pipe L M is formed narrower towards the bottom; at its upper end it is two inches bore, and at its lower end one inch; thicknesses of the metal is ½ inches.
- The Chremnitz foot is to the Paris foot, as 1538 to 1440; the pound, as 105 to 92. The Paris foot to the English, as 32 to 30.

A cubic foot of water of the mine weighs 72 lbs.

- The upper vessel A contains 57½ cubic feet, and the lower vessel B 273.

Twenty-five cubic feet are raised at every operation, and sometimes 3½ feet, as the water descends from the upper or lower reservoirs at O, the duration of the operation being different; for when the upper cistern O is used at 260 feet of elevation, 20 or 21 draughts are made in an hour; but when the lower cistern is used at 143 feet elevation, only 17 or 18 draughts per hour.

Each of these vessels is call in three pieces, which are joined by flanges and screws, with a ring of lead and another of leather placed between each to secure the joint, and prevent the transmission of any fluid. M. Jars observes that the pipes would have been better if connected by flanges, in the manner shown by the figure; but the real practice is to drive the ends of the pipes into hollow cylinders of dry wood, bound with iron hoops; these anker tolerably well, and are of considerable durability.

The moveable plugs of the cocks C, E, K, are screwed in their places by caps or covers fastened down with screws.

The produce of water raised by this machine is thus estimated by Dr. Wolfe:

If the vessel A were completely emptied after each operation, the expense of water, when the fall of 260 feet is used, would be 1178.25 cubic feet in an hour, defending 260 feet; and the effect, or the water raised, would be 563.75 cubic feet to a height of 104 feet; or, when the fall of 143 feet is used, the expense per hour would be 1006.25 cubic feet, and the effect 481.25. But as it is not necessary that the vessel A should be much more than half emptied, the expense of water will be nearly equal to, or will not much exceed the quantity raised.
WATER.

It should follow, from experiments on the nature of air, that the column $F$ is counterpoised by the compressed air in the inverse ratio of $104:32$: hence the volume of air contained in the vessel $A$ and the pipe $LM$, equal to $58\frac{1}{2}$ cubic feet, must be reduced to $18$ cubic feet, before the elasticity will be equal to the prefocus of the column $CF$ $104$ feet; but by increasing the compression a little more, the water in $B$ will be made to flow out through $F$.

If, at the moment the vessel $A$ is full of water, the cock $H$ be shut, the water will continue to flow through $F$, until the air occupies a space of $18$ cubic feet in the vessel $B$, and in the pipe $LM$; the elasticity of the air will then be in equilibrio with the column $F$, and the efflux of the water through $F$ will cease. In this manner, not above $17$ cubic feet of water are evacuated at each draught, and $104$ cubic feet are constantly left in the vessel $B$.

But if the cock $H$ is not shut the very moment that the vessel $A$ is full, the water in $A$ will follow the air through $LM$, and, before it gets to the vessel $B$, will raise one cubic foot more out of that vessel. After the water from $A$ enters into the vessel $B$, the discharge of the $F$ will not be the water of $B$, but the water of $A$ descending and ascending again by a single circuit, until $H$ be shut; which being done, the water will continue to flow at $F$, until the remainder of $104$ cubic feet is expelled from $B$ by the air contained in it. The moment when the water from $A$ has descended into the lower vessel $B$ may easily be known, by the velocity of the efflux at $F$ becoming suddenly three times greater.

That this is actually the case is proved, because sometimes $31\frac{1}{2}$ cubic feet are discharged; which quantity exceeds the capacity of the vessel $B$ by more than $4$ cubic feet.

This inconvenience might easily be prevented, by giving to the pipe $S$ a diameter of $18$ inches; for then there would have remained only the just space of $18$ cubic feet for the compressed air.

The height of the column $T$ to the lowest of the two receivers at $O$ is $143$ feet, which, taken upon the diameter of the vessel $A$ as a base, is equal to the weight of $823\frac{1}{2}$ cubic feet, and would compress the air into a fourth; or, when the water is descending into the lower vessel $B$, into a seventh part of its natural space, provided it were equally refilled at $F$. The vessel $A$ becomes filled at a mean in $8$ seconds; and in twice that space of time, $17$ cubic feet are evacuated through $F$.

The power of the column of $260$ feet from the most elevated reservoir, acting within the vessel $A$, is equivalent to the weight of $1495$ cubic feet of water. It can raise a greater quantity, if the vessel $B$ be so constructed as to allow no more than a just space to the compressed air. If the vessel $A$ were filled in $4$ seconds, then $17$ cubic feet of water would be discharged through $F$ in twice that time, and the air would be reduced into an eighth, and, during the descent of the water of the vessel $A$ into the lower vessel $B$, into an eleventh part of its bulk. But this makes no alteration as to the quantity of the effect; and when water ceases to flow out at $F$, there will always remain $104$ cubic feet of water in the vessel $B$.

Two men are required to attend it, but it would be very easy to connect the levers of the cocks above and below, so as to require only one man to work the whole; and indeed there would be little difficulty in making the machine work itself safely, without any attendant, except to let it off at first, or stop it when requisite. The machinery for this purpose has been proposed by Mr. Bofwell. See Nicholson's Journal, 410. iv. 117.

From what has been said, it is evident that this machine, though it answers the author's intention, is so deficient as to the effect the same fall of water might produce, as to bear scarce any proportion; and there is a defect in the principle of the machine, viz. that the air will require a considerable share of the power to compress it, and this air must be suffered to escape, before the vessels can be refilled to repeat the action; in consequence, all the power taken to compress the air is lost, and expands itself in forcing out a strong blast of air at the discharging cock, without producing any useful effect. Notwithstanding this defect, the cheapness and ease of construction, and the little wear and tear, together with the facility with which it may be made to work and stop for very short periods of time, are powerful recommendations of this machine, in such places as afford the requisite fall of superior water, and do not require a higher single lift than $15$ or $20$ fathoms.

A curious phenomenon has been observed in this machine, when it is near the end of its operation, that is, when nearly the whole of the water has been raifed out of the lower vessel $B$, and the cock $E$ be opened to give vent to the compressed air, and before the cock $L$ is shut, so that the air is followed up by the water, then if a hat or miner's bonnet be presented to the aperture $E$, the aqueous vapours will be discharged through the compressed air, and perhaps also, says M. Jars, part of those of the external air are condensed in the bonnet in the form of very white and compact ice, very much resembling hail, and not easily separated from the bonnet. It soon melts, which is not to be wondered at, as the temperature of the place itself is not cold.

It is observed that the air issues out with such impetuosity, that the workman could not hold the bonnet at the distance of a few inches from the aperture, as he does in this experiment, if he were not supported behind. The ice is much more compact, if the cock be only in part opened.

When the cock at which the air is discharged is opened, it rushes out with prodigious violence, and the drops of water are changed into hail or lumps of ice. It is a sight usually shewn to strangers, who are defir'd to hold their hats, to receive the blast of air; the ice comes out with such violence as frequently to pierce the hat like a pistol bullet. This rapid congelation is a remarkable instance of the general fact, that air, by suddenly expanding, generates cold; its capacity for heat being increased.

The formation of the ice and snow, when the condensed air rushes out of this machine, has been explained in a different way in almost every system of philosophy. It appears to us to be a necessary consequence of the condensed air, on rushing out into the open air.

The air of the atmosphere, and the water when taken into the machine, are nearly of the same temperature; and it may be considered that each cubic foot of water and of air contains some certain quantity of heat or caloric; but they will readily impart a portion of this heat to any body containing a less degree than themselves, or they will absorb or take up heat from any body containing a greater proportion of heat than themselves, in consequence of that property of heat, by which it will distribute itself equally among all bodies which are in contact with each other. By the action of the machine, the air is compressed into one-third of the space it before occupied, and the share of heat contained in that air is likewise concentrated or thrown into a third of the space, and in consequence becomes more intense. Some part of the
the heat will, therefore, be communicated to the surrounding water, until the heat distributes itself again between the water and the condensed air, so that they come to the same temperature. In this state, if the air is suffered to rush out of the vessel, it will suddenly expand and recover its former volume, and it must also recover its former share of caloric, which it can only do by abstracting heat from the surrounding air, or from any substance with which it comes in contact: hence the coldness of the blast of air. In respect to the formation of snow and ice, it must be considered that the air of damp places always contains a considerable portion of water in a state of vapour, and the air in this machine will have taken up more than the ordinary share, in conformance of being in contact with the water. When the air expands itself, the heat being suddenly abstracted from this watery vapour, it becomes fluid, and accumulates in drops like rain; which drops, by a farther abstraction of heat, become solid like snow or hail.

An instrument which is in common use to produce fire, by the sudden compression of air, shews the reverse of this action: it is a fire-engine fitted with a piston, which is air-tight; at the bottom of the barrel a small piece of tinder is placed. Now, if the piston is very violently and suddenly forced down to the bottom of the barrel, and the piston is then withdrawn, the tinder will be ignited. The heat contained in the air which fills the barrel is so concentrated at the same time with the air, as to produce actual fire. If the piston is forced slowly down, the air will be condensed to an equal degree, but no fire will be produced, because the heat has time to escape through the metal of the barrel, before it arrives at any considerable degree of concentration. We consider that in all cases when air (and perhaps other elastic fluids) is compressed into a smaller space, part of the heat it before contained will be given out to the surrounding matter; or if it is suffered to expand to fill a larger space, it will absorb or take up heat from the surrounding matter.

A larger Machine at Chremnitz.—This does not differ from the original engine, so as to require a minute description; but as this machine is not employed in England, and we think it might be useful in many cases in mining districts, we shall give the proportions and calculations of a larger machine, as a model for engineers.

### Height of the source above the place of delivery
- of fall of water, which is to work the machine:
  - descending pipe: 4 inches bore
  - 136 feet

### Depth from which the water is to be raised out of the pit to the place of delivery
- ascending pipe: 96 feet

### Cubic Feet
- Upper vessel: a copper cylinder 5 feet diameter, and 8 feet high; metal 2 inches thick; the descending pipe goes to within 4 inches of the bottom: contents 170 cubic feet
- Lower vessel: a brass cylinder 4 feet diameter, and 64 feet high; metal 2 inches thick; the ascending-pipe goes within 3 inches of the bottom: capacity 83 cubic feet
- Air-pipe which communicates between the two vessels: 2 inches bore, and 96 feet in length

To understand the action of this machine clearly:—Suppose that the lower cylinder is charged with water, and the upper cylinder with air ready for action, when the water from the source is admitted into the upper cylinder, if no issue was given to the contained air, the water would enter into the vessel, until the air was compressed into one-fifth of its bulk by the column of 136 feet high; for a column of 34 feet nearly balances the ordinary elasticity of the air. But when there is an issue given to the air through the air-pipe, it will drive the compressed air along this pipe, and it will expel water from the lower cylinder.

When all the air is expelled from the upper cylinder, there will be 34 cubic feet of water expelled from the lower cylinder. Now if the ascending pipe had been carried up more than 136 feet above the lower level, instead of 96 feet, then the water would have risen 136 feet high in that pipe, by the intervention of the elastic air, before it was in equilibrio with the water in the descending pipe; but no more water would have been expelled from the lower cylinder than what would fill this pipe.

But the ascending pipe being only 96 feet high, the water will be thrown out at the top of it with a considerable velocity. Were it not for the great obstructions which the water and air must meet with in their passage along the pipes, it would issue from the mouth of the ascending pipe with a velocity of more than 50 feet per second. It issues, however, much more slowly.

When the upper cylinder is become filled with water, the supply is stopped; but the lower cylinder still contains 34 cubic feet of compressed air of sufficient elasticity to balance the water in a discharging-pipe 136 feet high, whereas the ascending-pipe is only 96 feet. Therefore the water will continue to flow at the mouth of the ascending-pipe till the compressed air is so far expanded as to balance only 96 feet of water, that is, until it occupies one-fourth of its ordinary bulk, or one-fourth of the capacity of the upper cylinder, viz. 42 3/4 cubic feet. Therefore 42 3/4 cubic feet of water will be expelled, and then the efflux will cease, leaving the lower cylinder about one-half full of water.

When the discharging-cock of the upper vessel is opened the water issues with great violence, being pressed by the condensed air returning from the lower cylinder. It therefore issues with the sum of its own weight, and of this compression. These gradually decrease together, by the efflux of the water and the expansion of the air; and this efflux stops before all the water in the upper vessel has flowed out, because there are only 42 3/4 feet of the lower cylinder occupied by air. This quantity of water nearly will therefore remain in the upper cylinder. The workman knows this, because the discharged water from the upper vessel is received first of all into a vessel containing three-fourths of the capacity of the upper cylinder, which serves as a measure; when this is filled, the attendant opens the cock which admits the water into the lower vessel, by a long rod which goes down the shaft: this allows the water of the mine to fill the lower cylinder, and the air returns into the upper cylinder through the air-pipe, and permits the remaining water to run out of it; and when the attendant finds no more water will come out, every thing is brought to its first condition.

The above account of the procedure in working this engine, shews that the efflux at the mouth of the ascending-pipe becomes very slow near the end. On this account, it is found convenient not to wait for the complete discharge, but to cut off the supply when about 30 cubic feet of water have been discharged, and more work is done in this way.

A gentleman of great accuracy and knowledge of these subjects, took the trouble of noticing particularly the performance of the machine. He observed that each stroke, as it may be called, took up about three minutes and one-eighth, and that 32 cubic feet of water were discharged, and 66 cubic feet were expended.

The expense therefore is 66 cubic feet of water falling
WATER.

136 feet, and the performance is 32 cubic feet raised 96 feet, and they are in the proportion of \(66 \times 136 = 32 \times 96, \text{viz.} 8076 \text{ to } 3072\), that the power employed is to the effect produced, as 2.9 to 1. The quantity raised, \(\text{viz.} 32\) cubic feet, divided by the time 35 minutes, gives nearly 10 cubic feet per minute, and multiplied by the height raised 96 feet = 960 cubic feet raised 1 foot high. Divide this by 528 cubic feet, which is the horse-power, and it gives 1.8.

The machine is not therefore equal in effective power to a steam-engine of two-horse power, but the power employed is just equal to five-horse power.

When we consider the great obstruction which water meets with in its passage through long pipes, we find we may gain some advantage by increasing the bore of the descending pipe of supply. The quantity of water which descends through this is 66 cubic feet in 35 minutes, or very nearly 30 cubic feet per minute; the area of the four-inch bore is 12.5 square inches, and therefore 11.5 such areas would make a square foot. Multiply 30 cubic feet by 11.5, and we have 345 feet, which is the velocity with which the water must descend in the pipe. This is much too great, and it would be an improvement if the pipe was increased to six inches bore, and the velocity would then be only 151 feet per minute. The performance of the machine would then be greatly increased, we think as much as one-third; it is true that it would expend more water, but not in the same proportion; for part of the deficiency of this machine arises from the needle's velocity of the water in the pipe, as well as from the violent efflux of the water by the confluence of the air, as we have before mentioned.

The discharging-pipe ought to be 110 feet high instead of 96, and would not give feebly less water. It must be considered that the original expense of this simple machine would not be less than a water-mill which would raise 10 cubic feet of water, 96 feet high; in a minute; the repairs of it would be small when compared with a mill. And, lastly, let it be noticed, that such a machine can be used where no mill whatever can be put in motion.

A small stream of water, which would not move any kind of wheel, will raise one-third of its own quantity to the fame height, working as fast as it is supplied.

From its simplicity, we think the HUNGARIAN Machine (which is) eminently deserves the attention of mathematicians and engineers, to bring it to its utmost perfection, and into general use. There are many situations where this kind of machine may be very useful. Thus where the tide rises 17 feet, it may be used for compreling air into seven-eighths of its bulk, and a pipe leading from a very large vessel inverted in the tide-water may be used for raising water from another vessel of one-eighth of its capacity, 15 feet high; or if this vessel has only one-tenth of the capacity of the larger one, the tide-way, two pipes may be led from it, one into the small vessel, and the other into an equal vessel, 16 feet higher, which receives the water from the first. Thus one-sixteenth of the water may be raised 34 feet, and a smaller quantity to a still greater height, and this with a kind of power that can hardly be applied any other way.

Siphon Interruptus to raise Water by suction.—This machine is the reverse of the Chremnitz machine in its action, for the power of a defending column of water, running out of a close vessel, causes a vacuum therein; and another column of water is sucked up into the vessel, or rather forced up by the pressure of the atmosphere to fill the vacuous space. This machine is fully described by Leopold, in his Theatrum Mechanicarum Hydraulicae, vol. i. It is provided with apparatus to open and shut the cocks. It would be difficult to explain this machine without several figures, and we have therefore preferred to describe a machine of the same kind invented by Mr. Goodwin; he calls it a machine that will raise a body of water to any height not exceeding the height of that column which will counterbalance the pressure of the atmosphere, (lay 30 feet) and acts by the descent of part of the same body of water through a somewhat greater height, aided by the pressure of the atmosphere.

Let A, fig. 10, Plate Water-works, be a spherical vessel of copper or other metal, about 18 inches diameter; B, another sphere, about two feet six inches in diameter; C, a reservoir kept constantly supplied with water, part of which is to be raised up to E, by the power of another part descending to a considerable depth beneath the reservoir C. D is a glass cap, about six inches long, fixed on the top of the upper vessel A, for the purpose of seeing when the water begins to fill and has filled it; E is the upper reservoir into which the water of the reservoir C is to be elevated, and the contents of the upper vessel A is to be emptied; 1 is a pipe about half an inch in diameter, joined into the top of the lower vessel B, and rising upwards to within about an inch of the top of the glass cap D of the upper vessel; 2 is a pipe of the same diameter, and a few feet longer than 1, joined to the bottom of the lower vessel B, and descending downwards in a perpendicular or inclined direction, to a rather greater distance beneath C than the upper vessel A is elevated above C; 3 is a pipe one inch and a half in diameter, joined to the bottom of the upper vessel A, and palling upwards through the bottom to within two inches of the top of the glass cap D; 4, 4, is a pipe of about half an inch diameter, joined to the top of the vessel B, it passes through the bottom of the reservoir C, and rises above the surface of the water therein; 5 is a pipe of the same diameter, fixed to the top of the vessel B, and terminating in and fixed to the bottom of the reservoir C; 6 is a pipe or spout of the same diameter, fixed into the bottom of the upper vessel A, to convey the water into the reservoir E; 7 is a trumpet mouth-pipe fixed to the bottom of the pipe 3, and extending downwards beneath the water to within about an inch of the bottom of the reservoir C; 8, 9, and d, are cocks fixed to the pipes. The vessels, pipes, cocks, and joints, must all be air-tight.

In order to raise water from the lower reservoir C into the upper reservoir E, all the cocks being shut proceed thus: open the cocks b and \(\epsilon\), in order to fill the lower vessel B, and when B is filled, shut the cocks b and \(\epsilon\), and open the cock d. The water will then begin to run from the sphere B by its gravity, and by means of its communication with the upper sphere A, through the pipe 1, will draw off the air therefrom to supply the space left in the lower vessel B, by the running out of the water the air in A is thus rarefied. The atmospheric air at the same time preffing on the water in the reservoir C, will cause it to rise through the trumpet-mouth 7 of the pipe 3, and by falling over the top of the pipe 3 at D, it will fill the upper sphere A. When A is full, which may be seen through the glass cap D, shut the cock d, and open the three cocks a, b, and \(\epsilon\), the cock and pipe b will allow the atmospheric air to return into the vessel, and fill both with air, by which means the water contained in the vessel A will run into the elevated reservoir E, and B will be replenished for another operation. Then shut the cocks a, b, and \(\epsilon\), and open the cock d, and it will repeat the operation of raising the water into A.

If it be required to raise any body of water from reservoir C into reservoir E, by means of the descent of a body of some other water from the vessel B, a communication must be made into B, independently of the pipe 5, and
cok 2; viz. through a pipe-cock leading from another reservoir, as is represented by the dotted lines communicating with B near the pipe and cock 5; the action is the same as before; but the cock with the dotted lines is to be used in lieu of pipe 5, and cock 4. By this means, if the water which is employed to work the machine is foul or tainted, it will have no communication with the water which it raises. This machine has the same defect as the Chremnitz machine; viz. that the power which is expanded in rarefying the air is greater than the quantity of water raised, and the difference is lost when the cock in the lower vessel is opened, and the air rushes in.

A different Form of the Siphon Machine.—Mr. Goodwin's engine is formed upon a very elegant principle, and operates by the assistance of only a small quantity of water. It may be made in various forms, either to raise the fluid above the descending column, or from below to it, in an amount with the bottom, and the height may be doubled or trebled by proportionally increasing the descending mass, and raising several columns of water from different elevations at the same time, by combining two or more of the simple machines together, as is shewn in fig. 8. Plate Waterworks.

C, as in the former figure, represents the reservoir or source of water which is to work the machine; B represents the lowest of the two vessels which contain the rising and descending bodies of water; and the small square near fig. 8, represents the upper vessel A, fig. 10. These vessels are spherical in the original drawing, but to lessen the loss of space in defect, they are here made flat and cylindrical; E is the higher cistern of the original figure, into which the water is to be raised; 2, 3, and 4, are the pipes arranged in the same manner as the former machine; F, a vessel the same as A, with tubes 3 and 6; it communicates with the vessel B by a pipe, and is intended to raise water out of the cistern E into a higher and additional cistern G.

The vessels E, F, and G, form a second machine, which has the same parts and properties as the former, except that the lower vessel B is common to both, and serves as the lower vessel to exhaust and drive up the water both to A and to F; 2 is an enlarged tube like the original drawing, through which the water descends to produce the action; 5 is a hole in the top of B, instead of a tube. This hole, and the tubes 2, 4, and 6, must be provided with valves instead of cocks, which must be kept close by weights or springs, (while the water is rising) except the valve to tube 2, which must be open. The tubes 3, 5, may also have valves to support the raised columns.

Operation.—Fill the cisterns C and E with water, and let the lower cistern be constantly supplied; open the valves of the tubes 5, 6, 6, and close the valve of the descending tube 2, the vessel B then becomes filled through the hole 5. Now close the valves of the tubes 4, 5, and 6, and open the valve of the tube 2, the water then begins to descend out of B, and will exhaust the air from A and F, just as in the first-mentioned machine; the preface of the atmosphere on the surface of the water C, will raise one body of water out of C into A, and out of E into F; when B is nearly empty, or when A and F are full, open the tubes 4, 5, 6, 6, and close 2, then B will be filled a second time, and the vessels A and F will empty themselves into their respective cisterns E and G: thus the reciprocations continue without interruption.

Another body of water may be raised out of G into a higher cistern by additional apparatus, and by proportionally increasing the dimensions of the vessel B and the tube 2. The dotted lines represent the apparatus for raising water below the bottom of the tube 2, to be used instead of those above the cistern C.

This arrangement of the engine is of great utility in many cases, and in situations where this machine can be erected, it may be of considerable use for raising water out of mines for draining pieces of land, or elevating the water employed in domestic purposes.

Comparison of different Pressure-Engines.—In Mr. Nicholson's Journal, 8vo. vol. i. Mr. Boiwell has given a plan for constructing Mr. Goodwin's engine on a large scale, to operate without attendance of any person, to open and shut the cocks, and another method of raising the Chremnitz machine to raise water above the level of the prime reservoir; and he makes the following comparative view of the advantages of both kinds of engines and their powers.

It will be found that the powers and capabilities of these machines are nearly similar. If, in both the greater the height of the original fall of water from the source to the discharge, and the greater the quantity of water which it can supply in a given time, the greater quantity can be raised by either of these engines in a given time. 2dly, Both engines can be constructed so as to raise water above the original level, and from below, to the surface, or from a pit. 3dly, By a successive number of reservoirs, both engines can be brought to raise water to any height, but as they will raise a smaller quantity as the height is increased, the quantity wanted in a given time, and the expense of construction, will limit the extent of their elevation. 4thly, In both engines the distance of one reservoir from another must always be less than that of the original fall; the circumstances in which these engines differ arise from the difference in their manner of action. 5thly, The Chremnitz engine operates by causing a fall of water to compress the air, which reacting on other water, forces it to rise in a pipe to a certain height. The syphon engine acts by causing a fall of water to raise a certain quantity of air; in whole space the preface of the atmosphere forces a quantity of water when permitted. 6thly, Hence in the Chremnitz engine the preface acting from within outwards tends to burst the vessels used in the structure, and to open and extend any fissures which may chance to be in them. 7thly, In the syphon engine, the preface acting from without inwards, closes all the parts of which it is composed more together. 8thly, The Chremnitz engine will always raise water of a height nearly equal to that of the original fall from one reservoir to another, supposing the original fall of any height whatsoever as 100 feet. The syphon engine will not raise water by one reservoir so high as thirty feet in any case whatsoever, as there cannot be a complete vacuum formed by it in the air-chamber, but only an approximation to one.

From this comparison, it will follow that wherever the original fall of water is less than thirty-two feet, the syphon engine will be much preferable to the Chremnitz, as from the seventh article of the comparison it may be made of the cheapest materials, such as strong wooden casks and wooden pipes, whereas the Chremnitz engine from the sixth article must be made of the strongest, and of course the most costly materials, as metal, and that of considerable thickness; but wherever the original fall exceeds the height of thirty feet considerably, and it is required to raise the water to nearly the same height, then the Chremnitz engine appears to be preferable, as, in all probability, the fewer number of parts which it will require in this case will more than compensate for its cost in materials.

When it is required to raise water to a height much greater than that of the original fall above the first level, or from a greater depth, either from the original fall being short, or
the required height being great, it is better to employ an engine in which the preffure of the water is made to act by a piston in an apparatus similar to that of a steam-engine. (See our article Pressure Engine.) When neither the fpphon engine nor the Chremnitz can be ufed without a number of refervoirs, then the piston preffure-engine ought to be preferved, but this will much depend on the number of refervoirs; for perhaps one or two in addition to the Chremnitz might cost lefs than boring the cylinder of the piston-engine perfect, and conftructing its additional machinery. For merely raising water the powers of each are nearly equal, depending entirely on the height of the original fall of water.

It would be a great advantage of the piston-preffure engine if a fall of water could be applied to it without any waft, to work mills or machinery for any purpofe; this would be of very great confequence when the fall of water is of confiderable height, and the fpream or supply small. We have mentioned the advantage in this engine to have its action made elastic, by the addition of an air-chamber, on the fame principle as that ufed in engines for extinguifhing conflagration.

Mr. Bolfevillet suggests that this might be effected by making the piston hollow, and of a larger fize, to contain air for this purpofe, as the air’s clafficity would then act both on the upper and lower preffure of the water.

Machine for raising Water by the lateral Communication, from the Motion of a Stream of Water running through a conical Tube.

—This machine operates by fpotion, or more properly by the preffure of the atmofphere, and is in fome refpects similar to the fpphon machine. (See fig. 9. Plate Water-works.) A A repreffes a refervoir of water kept conftantly full, at the fame time that the conical fpout, B, is running full under a confiderable preffure; D, a fpherical copper veffel, with a tube, C, joined into its bottom, and rifing up within to some height above the centre of the fpere; E, another tube joined to the bottom of the fpere D, and terminating near its top; the lower part of this tube is bent, and the extremity of it is introduced into the smaller apertures of the conical tube B; F, a fpout or tube to empty the veffel D, when it is filled with water which has been raifed out of the refevoir A; G, a small tube pafling through the fpout F, and rifing to the top of the fpere, D, for the admission of air to quicken the defcent of water out of that veffel. Both thefe tubes are clofet at their lower ends by a leather valve at the end of the lever L, which lever is fixed upon the turning fplug of a cock in the tube E, and has a weight upon one end, in order that the other end may bear the valve up against the openings of the tubes F, G, with a confiderable ftrongnefs, and also to support the weight of the small bucket I, which is fpunched from the lever by a wire (at leat when the bucket is empty); H is a small ciftern to be filled with water from the refevoir A, in the fame time that the water is raifed up into D; this muft be done by regulating the cock, k, upon the pipe which supplies the ciftern with water. The ciftern H is provided with a fpphon, which will begin running as foon as the veffel is full of water, and will blow empty it. The small bucket I, which is fpunched from the lever L, is alfo furfurnifed with a fpphon-tube, which will begin to run and empty the bucket whenever it is quite full, but not before.

The operation of the engine will be as follows:—The refevoir A being kept conftantly full of water, and the conical tube B completely filled at its wider end by the water which runs out of A, the force of the lateral motion of the fluid will be increafed by the conical form of the tube B, and will act upon the end of the tube E to draw air out of the fame, fo as to rarefy the air in the veffel D; and the preffure of the atmofphere upon the surface of the water in the refevoir A, will caufe part of that water to rifce up the pipe C, to run over its top and fill the fphere D; it will then defcend through E, and join the fpream of water which flows out at B. When the veffel D is full of water, if the valve at the fpout F is opened, the water will run out.

In order to open the valve the cock k is regulated, that the ciftern H will be filled foon after D is full, and the fpphon of this ciftern beginning to empty the water it fills the bucket I, which then overbalances the weight upon the lever L, and opens the fpout F, and air-pipe G, and at the fame time closes the cock in E; the column of water in the defcending pipe C immediately defcends into the refevoir, and if the small tube G be full of water it will be emptied by the defcent of that column, and will admit air into D fo as to allow the water to flow out at F into the elevated refevoir. The fpphon in the ciftern H is regulated fo that the ciftern and the veffel D will be empty of water about the fame time, and the bucket I by its fpphon will become empty foon after: the weight upon the lever L will then close the fpout F, and open the fpream through E, when all the parts will fannd as at firft ready for a repetition of the operation of the lateral motion of the fpream, by which the water is raifed up into D as before.

If the water should defcend through E before F and G are opened, it will render the cock in E more tight. To quicken the reciprocation of the engine, and increafe the quantity of raifed water, a valve may be made to support the column of water in the fpotion-pipe; this valve may be placed in a chefl at the bottom of the pipe.

The defcending branch of the fpphon in the higher veffel H should be made of confiderable length, to prevent a confant dripping, and make the reciprocation end at once; the fpphon of the bucket I should fall as large in bore as the other, in order that the weight on L may preponderate quickly, and close the valve immediately.

The inventor entertains no doubt respecting the operation of a machine of this kind, and that a column of water may be raifed to any height not exceffing thirty feet by proportionally increafing the preffure of water in the refevoir, and the dimenfions of the conical tube.

In many situations, however, the requisite quantity of water for this purpofe cannot be had, and others may not admit of fufficient defcent.

Where the fpream has a confiderable defcent, the water may be raifed by a number of lifts instead of one, by combining as many machines. Suppose three refevoirs each with its conical tube or fpout through which the water runs from one to the other; also three exhausting veffels each with its elevated ciftern into which the raifed water is to be delivered; and the fpotion-pipe of each veffel draws its water from the elevated ciftern of the veffel below it. From each exhausting veffel a pipe is conveyed to the conical fpout of one of the three refevoirs, and the lateral motion of the fpream pafling through the fpouts of the three refevoirs will act upon all three engines at once.

In like manner, when there is plenty of water, but not convenience for a deep refevoir, feveral conical fpouts may be fixed to different parts of the refevoir, and all upon the fame level. Each machine muft be provided with a lever and weight to work its own valves, but they may be all opened at the fame time by the defcent of one veffel connected with all the levers, or each may have its reffpective bucket and fpphons.

This kind of machinery, by altering the position of the rareifying tubes, may be made to raifc water from a depth below the fpream equally as well as to a height above it; and
in situations where there is plenty of water and convenience for a reservoir a lower body of water may be conveyed into a stream above by the help of a single tube, one end of which is placed in the water to be raised, and the other must be introduced into the smaller aperture of the conical tube adapted to the reservoir; a constant stream will then rise, so long as water below can supply the tube.

Mr. Whitehurst's Machine for raising Water by its Momentum.—Fig. 7, Plate Water-works, is a representation of the first machine on this principle, which was executed in the year 1772, by the ingenious Mr. John Whitehurst, at Oulton in Cheshire, at the request of Mr. Egerton, for the service of a brew-house and other offices, and which purpose it was found to answer effectually. This first form of the momentum machine would be a useful application in many similar situations. The circumstances attending this water-work are as follows: A represents the spring, or original reservoir, which supplies the water, the upper surface coincides with the horizontal line BC, and the bottom of the reservoir K, into which the water is to be raised; D is the main-pipe, one inch and a half in diameter, and nearly two hundred yards in length; E, a branch-pipe, of the same dimensions, for the service of the kitchen-offices. It is to be observed, that the kitchen-offices are situated at least eighteen or twenty feet below the surface of the reservoir A; and that the cock F is about sixteen feet below it. G represents a valve-box, and g the valve within it; H is an air-veffel, and O, O, are the two ends of the main-pipe, inferted into the air-veffel H, and bending downwards, so that in effect the pipes communicate with the lowest part of the veffel, and the air cannot escape when the water is forced into it, but it must be comprised by the column of water; W is the surface of the water in the air-veffel. It is well known from theory that, when water is discharged from an aperture, under a preface of sixteen feet perpendicular height, it will move at the rate of thirty-two feet in a second; the velocity of the water from the cock F will be nearly as much, making some allowance for friction and reilitance; and although the aperture of the cock F is not equal to the diameter of the pipe D, yet the velocity of the water contained in the pipe will be very considerable; consequently when the cock is opened a column of water two hundred yards in length is put into motion, and if it is suddenly stopped by the cutting cock F, its momentous force will open the valve g, and condense the air in veffel H; this action will be repeated as often as water is drawn from F. It is needless to say in what degree the air is thus condensed in the intake before us; but it will be sufficient to observe, that it was so much condensed as to force the water up into the reservoir K, and even to burst the veffel H, in a few months after it was first constructed, although it was apparently very firm, being made of sheet-lead, about nine or ten pounds weight to a square foot. Whence it is reasonable to infer that the momentous force is much superior to the simple preface of the column in the reservoir K, above the level line CB, and therefore equal to a greater reilitance (if required) than a preface of four or five feet perpendicular height. It may be necexary farther to observe, that the commutation of the water in the kitchen-office is very considerable, because water is frequently drawn from morning till night all the days of the year.

From this account which is published in the Philosophical transactions for 1775, it is clear that Mr. Whitehurst was fully aware of the power of the momentum of running water, and though he applied it only to raise water to a small height, he knew it might be carried to a greater extent.

Montgolfier's Hydraulic Ram.—We have given the account of Mr. Whitehurst's machine, because it shows the first origin of a most valuable invention, which was afterwards practised in France by M. Montgolfier, the inventor of the first balloon with heated air. Mr. Boulton took a patent in England for Montgolfier's machine in 1797; he afterwards called his machine bolier hydraulaque, that is, hydraulic ram, because of the shock which the water makes when its motion is suddenly stopped. In his publication in the Journal des Mines, vol. xiii., he says, "This invention is not originally from England, but belongs entirely to France; I declare that I am the sole inventor, and that the idea was not furnished to me by any person. It is true that one of my friends, with my consent, sent to Missirs. Watt and Boulton copies of several drawings of this machine with a detailed memoir on its applications. These are faithfully copied in the patent taken out by Mr. Boulton in England, dated December 13, 1797, as that gentleman has avowed." We do not wish to detract from the merit of M. Montgolfier, as we believe that Whitehurst's machine was unknown to him, but we must flate the hydraulic ram an English invention. To have an idea of this invention, it is proper to state its physical principle of action, which is as follows.

When water is running with a rapid current through a pipe or cleft channel, if the end at which the water issues be suddenly stopped, the water (by its acquired motion, momentum, or impetus,) will act upon the sides or circumference of the pipe, and endeavour to escape with a force proportioned to its quantity and velocity. If the materials of the pipe are strong enough to resist this impetus, the water may be made to issue with violence and velocity, at any aperture which is opened in or near the cleft end of the pipe; therefore if an ascending pipe be joined to that aperture, a portion of water will ascend in it. The machine being provided with proper valves, to prevent the return of the water to the elevated, the operation may be repeated in a constant succession, and will form a kind of perpetual pump.

The same effect will be produced by a different arrangement of this apparatus, viz. a pipe open at both ends, with a valve and ascending-pipe, such as has been described. Let this be so attached to some kind of machinery, that it can be swiftly moved along, in the direction of its length, through standing water; then, upon closing the hinder part of the pipe suddenly, a portion of water will be forced up in the ascending-pipe, in the same manner as in the former case, and for the same reason, because the water will be relatively in motion with respect to the pipe.

The same principle may be readily extended to raise water by suction from a lower level than that to which the machine is placed, and this by either of the means above mentioned. Suppose a suction-pipe, which communicates with water at a lower level, be joined to the main-pipe through which the water flows, and that the junction is near that end of the pipe where the water enters into it. Suppose also that the water has acquired a rapid motion through the pipe, either by the current of water running through the pipe, or by the pipe moving through the water; then let the mouth or end at which the water enters be suddenly shut by the machinery, and the water by its momentum will continue its motion relatively to the pipe, and will tend to exhaust the content of the pipe. This action will draw or suck up water through the ascending-pipe from the lower level, so as to fill up the vacuum in the main-pipe, occasioned when the water therein percolates in its previous motion.
WATER.

The first and most simple hydraulic ram is shewn in section at fig. 4. (Plate Water-works) ; here C C represents the main-pipe, or body of the ram, through which the stream of current water is conducted; D, the ascendent-pipe provided with a valve of exit at A, to allow the passage of the water which is raised, but to prevent its return; B is a stop-valve to close the end of the main-pipe; E is a balance-weight fixed upon the lever G, which communicates with another, K, attached to the axis of the stop-valve B; this weight tends to open the valve at the proper time. The main-pipe is to be situated in a current or stream of water, either produced by the natural current or declivity of a river or other stream, or by penning up the water by a dam or weir, and injuring the end of the main-pipe through the dam, so as to obtain the greatest fall of water which the natural circumstances will admit of. To put the machine in action, let the stop-valve be opened to the position shewn in the figure, the water will run through the main-pipe C, until it acquires a certain velocity which will be proportioned to the height of the fall of water which produces the current of water. The action of the current upon the stop-valve B, in its reclined position, will increase until it is sufficient to overcome the weight E, and then it will shut the stop-valve. The water being now suddenly stopped, and confined in the pipe C, by its impetus or momentum, will exert a considerable force within the pipe, which will open the other valve A, and a portion of the water will rush up the ascendent-pipe D. The force of the momentum being expended in raising this water, the water in the main-pipe will immediately recover the equilibrium, and the closing of the valve A will prevent the return of the water which is raised in the ascendent-pipe. The weight E now descends, and opens the stop-valve B, and the water in the main-pipe refines its motion until its velocity is sufficient to close the valve A again, and the operation of raising the water is again repeated.

This water gradually rises in the ascendent-pipe until it reaches its summit, and then a quantity will issue from it at every stroke into a proper reservoir R. The quantity will be more or less, according as the height to which it is raised, and to the velocity of the current, and the size of the apparatus. In this description, we have taken no notice of the action of the air-vessel J, at the bottom of the ascendent-pipe D, although its use is very important to the practicability of the contrivance; for where the water is to be raised to any considerable height, the pipes, although formed of the best materials that can be procured, will be in danger of rupture from the great concussion of the water when suddenly checked; hence the rising of the water would be limited to the height of a few feet, or the pipes must be made of an extraordinary thickness, disfiguring and expensive.

This danger of bursting the pipes is to be regarded in every case of applying this invention to practice; but it will be prevented, or very much diminished, by introducing an air-vessel J. The water from the main-pipe enters at every stroke through the exit-valve A, and compresses the air in the vessel J, which, again, by its expansion or elasticity, acts upon the water, (which is prevented from returning to the pipe C by the shutting of the exit-valve,) and therefore rises through the ascendent-pipe, and by repeated strokes acquires the desired height.

The dimensions of the air-vessel, as well as its form and position, and whether it is affixed to the main-pipe laterally or above, are in a great measure arbitrary; but its contents of air ought not to be much less than ten times the quantity of water to be raised through the ascendent-pipe at each stroke, and if very much larger fill the better, the principal boundary being expense.

The regulation of the stop-valve B, is a principal point in the contrivance of these machines. It may be opened and shut by the current, as has been described, in a very simple manner, by adapting the valve to move upon an axle or hinge, and affixing it to open at the proper time by a weight attached to a lever fixed to its axis at the proper angle. The valve should be prevented from opening to such a degree, that the action of the current of water could not shut it. This must be done by some fixed resistance behind the valves, as shewn as B, fig. 3, or by any other convenient means.

It is necessary to adjust the weight by experiment, so as to open the valve at the right time, according to circumstances, which may be done either by sliding the weight nearer to, or farther from, the centre of motion, or by increasing or diminishing the weight itself. The inconvenience of this method is, that the weight being generally under water, it is troublesome to adjust it; therefore the mechanism shewn in fig. 4, is better adapted to the stop-valve. The weight E is fitted upon a lever connected with a spindle, to which another arm or lever G is also fixed, and that is connected by rod a, with the arm K fixed to the valve.

The rod may be prolonged to any necessary length, and the weight and its mechanism may be always placed above water, so as to be easily come at for adjustment. Valves of this kind may be hinged either upon their lower or upper edge, or upon one of the perpendicular sides as a common door, as convenience requires, and the mechanism is connected accordingly.

When it is required to open the stop-valve so completely that the current of water in the main-pipe cannot act upon it, to shut it, a small stream of water is led from the head, which supplies the main-pipe, or from some other source into a pipe or trough, which is furnished with a cock to regulate the quantity. This pipe or trough pours its water into the reservoir G, fig. 5, which conduces the bucket to preponderate, and by means of the lever b c, fixed to its axle, and the rod e d attached to it, it shuts the stop-valve B, by the connection of the lever d e attached to it. The bucket then empties its water, and the pendulous weight E, as soon as the recoil of the water in the main-pipe takes place, preponderating in its turn, opens the valve, and restores the bucket to its place. In this contrivance, by opening the cocks of supply more or less, and by adapting the capacity of the buckets in proportion to the weight E, the number of strokes to be made in any given time is regulated.

The stop-valve may be constructed in a circular form, and, instead of being hinged upon one side, may be fixed upon a spindle in its centre, which slides in a socket, similar to what are called button-valves used in pump-work, and at the proper time is opened by mechanism similar to the former; or, in place of the weight, a spring may be employed.

In constructing large machines, where the shock, from shutting the stop-valve, might endanger the derangement of the machine, other kinds of stop-valves will be preferable to those before described.

A very good form of valve is that which opens in two leaves, like the gates of a canal-lock. The leaves may shut one upon another in the middle, or may shut upon an upright bar placed there. They are opened by the same kind of mechanism as we have described before, only there must be two connecting-rods, one to each leaf of the valve; and the
thee being united together, will cause them to float both together. The aperture for this valve is of a rectangular form.

A valve in two leaves, such as is called a butterfly-valve, may also be hinged in the middle of the opening, but would too much obstruct the water-way. When the main pipe is of a large diameter, (for instance, two feet or upwards,) the stop-valve may be made in three, four, or more leaves connected together by mechanism, similar to Venetian window-blinds.

Another kind of valve is poise upon an axis, like a common fire-rove chimney damper; the axis does not pass through its centre, but divides it into two unequal segments. The valve is not opened so far as to stand in the line of the current of water, but, when opened, stands inclined to that current; so that the larger segment being placed towards the flume, the latter may by its action shut it at the proper time. It is opened by mechanism similar to the former. Another kind of valve is a spherical ball of porcelain, which is fitted into a foot.

When the machine is made use of in an open river, which does not admit of having its water penned up by a weir or dam-head, the main pipe ought to be laid so as to be covered by the low waters of the river; and it ought to be parallel to the surface of the river, so as to have the greatest possible declivity that can be obtained in the length of the main pipe: its mouth or receiving end should be shaped like that of a trumpet or bell. In all cafes whatsoever, the valves ought to be completely under the surface of the water, in the lower reservoir.

Performance of the hydraulic Ram, (see Ram.)—M. Montgolfier, in his publication, says, that a belier hydraulique, executed with care, is capable of rendering three-fourths of the force which is employed to move it, that is, the product of the weight of water raised, multiplied by the height to which it is raised, will be equal to three-fourths of the product of the weight of water which works the machine, multiplied by the height of the fall. Commonly it yields six-tenths, but he would only engage to furnish half. Thus, if the water was to be raised 100 feet by a fall of 5 feet, he would engage to make a machine which should deliver at 100 feet a fourth part of the whole quantity which fell. He recommends particularly that the machine should be fixed in the most solid manner, by masonry or timber, so that the shock of the water can produce no motion of the machine, because all such motion will deduct considerably from the quantity of water raised. It is stated that the machine will make from 20 to 120 strokes per minute.

The dimensions of an hydraulic ram, at the bleaching works of M. Turquet, near Senlis, in France, when reduced to English measure, are as follow: diameter of the body of the ram 8 inches, fall of the water 3 feet 4 inches, height to which the water is raised 15 feet 1 inch. In three minutes this machine made 100 strokes, which expended 67 cubic feet of water, and raised 9½ cubic feet: hence, 67 cubic feet X 3½ feet = 223, and 9½ cubic feet X 15 feet = 140.

feet = 140. Now \( \frac{140}{223} \) is equal to \( \frac{6}{25} \) th of the power applied. The effect produced is above six-tenths of the power applied. In another experiment it was found to be 64-hundredths. This machine raised a quantity of water equal to 6.2 inches of water (pouces de fontanier), for 269 litres which are nearly equal to 280 pints, in three minutes; and the pouce de fontanier is a measure of running water equal to 14 pints (French) per minute, or 796.37 cubic inches, English. This ma-

chine working 24 hours will raise 134400 pints (French), or 4512 cubic feet English, of water to a height of 15 feet 1 inch. The water raised by this machine is equal to \( \frac{2}{3} \) the power of a man, according to our standard.

M. Montgolfier recommends the pipe or body of the ram to be of an equal diameter through the whole length; and all internal irregularities are to be avoided, because they diminish the velocity of the water: the length of the pipe should be at least equal to sustain a column of twice the height to which it is intended to raise the water.

He says, that he executed one with a fall of 10 feet, which compressed the air in an air-veil to an equal degree with 40 atmospheres, which, taking the preasure of the at-mosphere equal to 33 feet of water, makes the preasure equal a column of water 1320 feet in height.

Improved hydraulic Ram.—M. Montgolfier, the son of the inventor, has recently obtained a patent in England for an improved hydraulic ram, in which, by attention to some minute particulars in the construction, he is enabled to make the length of the tube much less than in the former machines; and he has even obtained a result equal to 84 per cent. of the power employed.

One of these improvements is the addition of a small floating-valve, which, at each movement, serves to introduce a small quantity of air into the head of the ram, from whence it is driven by the next movement into the air-veil, which would otherwise become filled with water, if the air, ab-sorbed by the contact of the water under a strong preasure, were not continually replaced by some such means.

Also, in the interior of the head of the ram is an annular space, surrounding the frame of the float-valve: this contains a small volume of air, which cannot be forced into the air-veil, but which, at each movement, is compressed by and receives the first effort of the moving water. This he calls the air-mattafa, and by means of it, the shutting of the float-valve makes less noise, the pipe is not strained, and all the operations take place with in much ease, that the machine is less shaken, and less frequently out of repair. The following is a description of the new machine.

That end of the pipe or body of the ram which receives the water of the referovoir is formed like a trumpet-mouth, that the water may flow more readily into the pipe; and the length of the pipe must be regulated according to the height of the fall of water, which is to produce the current through it. The pipe is composed of several pieces or lengths screwed together by flanges, or other similar means; but it is in the end piece, which is called the head of the ram, that the moving parts of the machine are placed.

The extremity of the pipe or head of the ram is a hollow sphere, the diameter of which is nearly twice as great as the bore of this pipe: the upper part of the spherical end is flattened, so as to reduce it to a segment of a sphere, with a flat circular surface on the top or upper side, in the centre of which surface is a large circular opening to receive and hold the float of the float-valves, at which the water issues; but when the valve is closed, it prevents the water from issuing.

When the valve opens, it descends perpendicularly into the hollow sphere, and leaves a free passage through the opening. Its motion is guided between three or four perpendicularly fixed stems, which have hooks formed at the lower ends to retain or support the valve when opened; and these stems are fixed by ferews, so that they can be regulated to allow the valve to descend more or less, and open a greater or less passage for the water. The valve is made of metal, and hollow, for it has a flat circular plate of metal, with a hollow cup or dish of metal attached to its lower surface; this
this at the same time renders the valve lighter in the water, and gives it a convex surface on the lower side, which, when the valve is opened, corresponds in curvature with the interior concave surface of the spherical end of the head of the ram. The seat of the valve is composed of a short cylinder or pipe, of which the opening is much greater than the transverse section of the body of the ram. This short cylinder is screwed by its flange into the opening in the upper surface of the head of the ram. This flange of the seat is so formed as to have an inverted cup round the upper part of the short cylinder, that is, a circular channel or annular space within the head of the ram, which will contain air, and from which the air cannot escape when the water compresses. The air in this channel is called the air-matras.

The flinking-valve is at the end of a small pipe, which leads from the annular space or matras to the open air. The flinking-valve opens inwards, in order to admit the air to enter into the matras; but to prevent its return, there is another small valve in the same pipe, which opens outwards: the office of this is to admit a certain quantity of air into the matras, and then to shut and prevent any farther entrance.

On the outside of the seat of the flap-valve that is over the aperture in the head of the ram, where the water issues, another flap-valve is applied, which is similar to the internal valve before mentioned, but shuts down on the outside of the seat. Its use will be hereafter explained.

The upper part of the pipe or head of the ram is made flat at the part near the end where it enlarges to a sphere; and this flat surface on the top of the pipe has several narrow openings across it, which are covered by as many flap-valves of leather, to allow water to pass out from the main pipe, but to prevent its return. And on each side of the head of the ram, at the part opposite to these flap-valves, is a hollow enlargement, in form of a segment of a horizontal circle; and the two enlargements taken together form a circular bafon, through the centre of which the pipe of the ram passes; but, as before stated, the pipe, instead of being circular, is flat at that part, to form the seats for the flap-valves. This circular bafon is covered by a cylindrical air-valve, screwed down by means of a flange at the edge, so that the circular bafon forms the bottom of the space in the air-valve; the flap-valves being covered by the air-valve are therefore within the valve.

In consequence of this arrangement, all the water which issues from the body of the ram through the flap-valves will flow off on each side, and be received in the bafon; but as the circular bafon or bottom of the air-valve is divided into two parts, by the pipe of the ram which passes through it, there is a passage communicating from one of the enlargements to the other; for which purpose, it curves down and descends beneath the pipe of the ram; and the ascending pipe that carries away the water which the machine raises, proceeds either from this curved passage or from some other part of the bafon, so that it may receive the water which has passed from the body of the ram through the flap-valves and the air-valve into the bafon, at each side of the pipe.

The action of this hydraulic ram is nearly the same as the preceding. Suppose the pipe or body of the ram is full of water, if the internal flap-valve is opened, the water from the reservoir will flow through the body of the ram, and issue through the opening at the end, it will lift up the external flap-valve and escape; but the current having continued until the water has acquired a certain velocity, the force of the current buoyed up the internal valve, and closes the passage. The motion of the water contained in the ram will thus be suddenly arrested, and by its vis ineritie, or moving force, will exert a sudden pressure against the flap-valve, and against all the interior parts of the ram. The small quantity of air contained in the space around the interior flap-valve, which is called the air-matras, is compressed into a smaller space, and, by its elactity, takes off the violence of the shock or blow which would otherwise be produced. This pressure opens the flap-valves on the top of the pipe, which are within the air-valve, and a portion of the water will be driven into the air-valve, which is supposed to be full of air, compressed or condensed, till its elactity equals the pressure of the column of water which is to be raised up the ascending pipe by the action of the machine.

The water which is forced into the air-valve causes the air therein to be condensed, and to exert a greater degree of elactity, until it will exceed the pressure of the column of water in the ascending-pipe; by degrees this air will therefore force through the said pipe all the water which was injected through the flap-valves, and cause that quantity of water to issue from the upper extremity of that pipe.

The moving force, or vis ineritie of the mass of water, which was in motion in the body of the ram, having expended itself by forcing a portion of water into the air-valve, and making a full greater compression of the contained air, a recoil of the water in the body will take place with a flight motion from the valve towards the open end of the body; this arises from the reaction or elactity of the air contained in the air-matras, and also of the metal of which the tube is composed.

The flap-valves within the air-valve shut, and prevent the return of the water which has been forced into the air-valve. This recoil of the water in the body towards the open end causes a flight aspiration within the whole body of the ram, and the external flap-valve defends by its weight, and prevents the water with which it is covered from entering through it; but the air passes through the small pipe, leading from the open air to the annular space or air-matras, and opens the flinking-valve, and a small quantity of air is sucked into the matras; but this is a very small quantity, because the external air-valve closes as soon as the air flows with a rapid current through the pipe and flinking-valve.

During the recoil, the internal flap-valve having nothing to fulfill falls by its weight, and opens the passage; and as soon as the force of the recoil has expended itself in acting against the column of water contained in the reservoir at the open end of the body, the water begins again to flow through the body in its original direction, and repeats the action before described.

It shuts the internal flap-valve when it has acquired the intended velocity, and being thus stopped, the efflux of the vis ineritie condenses the air-matras, and opening the flap-valves, forces a quantity of water into the air-valve, from which the reaction of the contained air will drive it up the ascending-pipe.

The vis ineritie of the moving column of water being thus expended, the recoil commences by the reaction of the air in the matras, the flap-valves shut, and the external flap-valve likewise; the aspiration produced by the recoil draws some air through the flinking-valve, and it joins the air in the matras. The internal flap-valve falls open by its weight and opens the passage, so that the water in the pipe can resume its motion when the recoil has exhausted itself.

The small quantity of air which is drawn into the machine through the air-valve, at each aspiration, causes an accumulation
cumulation of air in the matras; and when the aspiration of the recoil takes place, a small quantity of this air passes from the annular space, and proceeds along the pipe till it arrives beneath the flap-valve, and lodging in the small space beneath these valves, it will be forced into the air-veffel at the next stroke, by which means the air-veffel is always kept filled with air.

The following are the dimensions of a machine which is calculated to raise water up the tube to 100 feet above the surface of the water in the reservoir, when the fall by which it is worked is five feet, that is, where the level of the water in the reservoir is five feet above the lower level; and the length of the pipe from the open end to where the water is discharged is to be twenty feet long, and six inches in diameter.

Such a machine may be expected to expend about seventy cubic feet per minute to work it, and to raise up about two and one-third cubic feet per minute; but these quantities cannot be exactly stated, because they depend upon the care and accuracy with which the machine is constructed.

The improvements in this last form of the hydraulic ram are:

First, that by constructing the head of the ram with the upper side of the pipe flat, and applying the flap-valves immediately upon the top, there is very little space to contain dead water, that is, water which will be motionless when the current takes place in the pipe; and by dividing the single valve of the original machine into several small and narrow valves, they open and shut more suddenly, and with less loss of water.

Secondly, in making the basin on each side of the pipe, which basin is on a lower level than the flap-valves. By this means the water will flow off from the flap-valve on each side, and at the instant when the machine performs its stroke, and forces water through the said valves into the air-veffel, the valves will not be covered, or at least very slightly covered by water; consequently, when those valves open, and the water is forced into the air-veffel, it has only the compressed air to oppose it, which from its elasticity allows the water to enter with more facility than if it was resisted by a column of water resting upon the valves; not that there is any lefs hydrotatic pressure upon the valves, because it is the air which bears upon them, instead of the water, but there is a lefs mass of matter to be put in motion by the water which enters into the air-veffel; for it has only the matter contained in the valves themselves to put in motion.

Thirdly, in applying the external flap-valve, the use of which is to prevent the water returning into the ram when the recoil takes place, and having this provision, a greater quantity of air can be employed in the matras than could otherwise conveniently be done; this renders the shock which takes place when the flap-valve is shut less sudden. We have examined several of these machines made in France by the inventor, and can with confidence recommend them to engineers as the very best machine, and the most simple for raising water when there is a natural fall. The last improvements, as they enable us to shorten the length of the body of the ram to nearly one-third, without reducing the performance, are very important.

The hydraulic ram is adapted to give motion to the hydraulic press, which are in common use under the name of Bramah's press. For this purpose, it is only necessary to apply the ascending-pipe to the cylinder of the hydraulic press, and at each stroke of the ram a small quantity of water will be forced or injected into the cylinder of the press, and will thus produce the ascent of the piston of the press in the same manner as is now performed by the small injection-pump worked by the force of men. But by the application of the hydraulic ram to that purpose, the press can be worked in any situation where there is a small fall of water, and the ram may be set in motion whenever the press is wanted.

An Hydraulic Ram, or Momentum Machine acting by Saturn, is shewn at figs. 2 and 3. This is applicable in cafes where the water to be raised is below level of the main-pipe, and is to be discharged at that level; a cafe which frequently occurs in the drainage of marshy lands, where the action of the current of water, in an embanked river, or other stream or source of water on a higher level, can be employed; or this method can be applied in raising water out of the holds of ships by the motion of the veffel through the water; also to raise water out of a well of moderate depth.

C represents a portion of the main-pipe; B, fig. 2, is the flap-valve situated at the entrance of the pipe, and opening towards so as to stop the passage of the pipe when it is shut; D, the ascending or fucking-pipe, communicating with the well at the bottom and with the main-pipe at the top; J is the air-veffel; and E the weights of the flap-valve of the main-pipe. There is likewise a valve A opening from the air-veffel into the main-pipe.

The water in the main-pipe having acquired a proper velocity by the current, as in the former cafes, the flap-valve J shuts, and the water in the main-pipe continuing its motion for a time, draws air out of the air-veffel, J, through the valve A. The momentum of the water in the main-pipe being soon expended it recoils, the receiving-valve A shuts to prevent the return of the water into the air-valve, and the flap-valve B opens by the action of the weight E, the water thus regains its passage, and soon acquires sufficient velocity to close the flap-valve again, and the operation is repeated.

Thus in a few strokes the exhaustion is increased till the air-valve lucks up water from below, through the ascending-pipe D, or rather the pressure of the atmosphere on the surface of the valve below forces it up, when the pressure on the surface within the air-valve is removed by the exhaustion. This action being continued, the ascending-pipe fills by degrees to the top, after which, at every successive stroke, a portion of the water from below passes into the main-pipe, and is carried off into the pipe C, where it mixes with the upper water.

In cafes where the water of the tide or other alternating current is employed as the motive power, the apparatus may be constructed in two ways, either by applying a flap-valve, air-valve, and ascending-pipe, such as is shewn at one end in fig. 4, to each end of the main-pipe C, to be used alternately, according as the tide sets in one direction or the other; or otherwise by applying two main pipes to one air-valve, their mouths being placed in opposite directions and to be used alternately, and applied to the raising of water, for the use of falt-works, or for other uses, such as the supply of a country-house.

The first machine above described may be employed to raise water to small heights by the motion of the waves of the sea, or of any large pieces of water; in which case the mouth or receiving end of the main-pipe should be formed like a speaking-trumpet, as shewn in fig. 4, and placed opposite to the direction in which the waves beat upon the shore at the place where the machine is. The water of the waves will enter the main-pipe, and rush through it until the
the flop-valve shuts when the contained water will in part enter the air-veflel by the action already described, and the next wave will produce anotherroke.

Momentum-Pump, or Momentum-Machine, to raise Water by the Application of mechanical Power.—Where a fall of water cannot be obtained, fig. 1. shews an application of this momentum principle, in lieu of pumps for raising water, the main-pipe being put in motion through the water by the strength of a rope or other mechanical power in default of a current, as in the other cafes.

C C is the main-pipe bent in a spiral form round the air-veflel J; it may either be made to touch it, or be kept at a distance from it, and may make one or more revolutions round the faid veifel; the whole of the main-pipe is immerfed in the external water which is to be raised. Both ends of the pipe are open to the water; but one of them has the flop-valve opening inwards, which will occaflionally clofe it, and near this latter end, a communication is made by a fide-pipe with the air-veflel, the orifice being covered by a valve opening into the veifel. The whole turns upon a pivot K, at the lower end of the ascending-pipe D, which turns as an axis, and is kept upright by a collar, in which it turns, as fhewn at L. Upon this axis a toothed wheel M is fixed, and is put in motion by another wheel N, turned by a winch, crank, or other contrivance.

At the top, or upper end of the ascending-pipe, the water is difcharged into a trough, which furrounds it, and conveys it to the place of its definition.

This apparatus is made to raise water by a continued ro- tative motion, the open end moving softly, through the water which paffes out again through the other end; but whenever, by that motion, the main-pipe has attained a proper velocity, the flop-valve shuts suddenly, and by the concufion of the water paffes into the air-veflel, from whence the effegs of the water is prevented by the futting of the exit-valve. The flop-valve then opens by means of a fpring in lieu of a weight, as in the former cafes, and the apparatus continuing to revolve in the fame direflion, morerokes are made at intervals proportioned to the velocity with which it moves. The fpring of the flop-valve fhould be fo regulated in force as to allow the relative motion of the water in the main-pipe to flut the flop-valve at proper intervals. The perpendicular fecti on of the main-pipe is drawn fquare, but may be circular, or of any other convenient figure. A horizontal fecti on of it is fhewn at fig. 6, with the main-pipe and the air-veflel.

In lieu of the wheel N, which produces a continued ro-tatory motion, the machine may be made to vibrate or fwing upon an axis, backwards and forwards, the limits of the vibration or froke being determined by a detent fliring againf{ the fpring. In this cafe, the main-pipe fhould be provided with frop-valves at both ends, and also have a communication at each end with the air-veflel, which openings fhould be clofed by valves to prevent the return of the water from it. Such a machine may be put in motion by the following means: upon the ascending-pipe D, a double pulley is fixed, round which are wound the ropes, and by pulling the ends of these alternately, the apparatus may be made to revolve in either direction. The main-pipe and the ascending-pipe being filled with water by hand or otherwife, if the ropes are pulled alternately, they will make the pipe move through the water with fufficient veloci ty to make the apparatus act. It is found if the appa ratus makes about thirty vibrations in each minute, that it will act very completely.

Hydraulic machines are of the greateft importance to society, whether we look to a supply of the firft neceffity for domestic ufts, or to the advantageous ufts of neglected though valuable first movers. These machines mutt, in mott cafes, be modified by localities, and other circumftances; and confequently the most uflful praftical knowledge will not confift in any acquaintance with one or more of the belt engines, but with that great variety of happy contrivances which inquiry and reflection must point out. We have, as far as our limits permit, given all the machines which are praftically uflful, and we shall conclude this article by giving Mr. Young's catalogue of the moft important and valuable writings on hydraulic engines.

Ramelli's Collection of Hydraulic Machines, in French and Italian, 1588, folio.


Nouvelle invention de lever l'eau plus haut que la source avec quelques machines mouvantes par le moyen de Peau, &c. par J. du Caus, 1657.

Josephi Gregorioui a Monte Scar. Principia phifico-mechani ca diversarum machinarum seu instrumentorum pneumaticorum ac hydraulicae, Venet. 1664.

Nouvelle Machine Hydraulique, par Francini Journ. des Scav. 1669.

[An account of this machine is likewise given in the Architecture Hydraulique de Belidor, tom. ii.; and in the 2d vol. of Defaguliers' Experimental Philosophy: in both which performances many other hydraulic machines are des cribed.]


M. de Hautefeuille, Reflexions fur quelque Machines a elever les eaux, avec fa description d'une nouvelle pompe, fans frorrowement, et fans pifton, &c. 1682.

Elevation des eaux par toute forte des Machines, reduite a la fmeure, au poids, la balance, par le moyen d'un nouveau pifton et corps de pompe, et d'un nouveau mouvement cyclo-ellipfique et rejettant l'ufage de toute forte de manivelles ordinaires, par le Chevalier Morland, 1685.


The solutions by Dr. Vincent and Mr. R. A. in No. 177.


D. Papin nouvelle maniere pour lever l'eau par la force du feu ; 8 Caffel, 1707.


Jacob Leopold, Theatri machinarum hydraulicarum, 1724 et 1725.


A Description of the Water-works at London-bridge, by H. Brightt, F. R. S. Phil. Tranf. 1731. No. 417.

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WATER.

An account of a new engine for raising water, in which horses or other animals draw without any loss of power (which has never yet been practiced); and how the froths of the piston may be made of any length, to prevent the loss of water by too frequent opening of valves, &c. by Walter Churchman. Phil. Trans. 1734.


[M. Segner's machine is no other than the simple yet truly ingenious contrivance known by the name of Barker's mill, which has been described in the 2d volume of Delfaguliers' Philosophy, some years before the German professor made any pretensions to the honour of the invention. The theory of it is likewise treated of by John Bernouilli at the end of his Hydraulics.]


Maximes pour arranger le plus avantageusement les machines destinées à élever de l'eau par le moyen des pompes, par M. L. Euler, Mem. Acad. Ber. 1752.


Abhandlungen von der Wasserfläche, von D. Scherffer, Prieffter Wien, 1774.

Recherches sur les moyens d'exécuter sous l'eau toutes fortes de travaux hydrauliques, fans employer, aucun épuisement, par M. Coulumb. 1779.

Saemund Magnusse, Holm, Efterretning om fkye pumper, Kiøbenhavn, 1779.

Moyen d'augmenter la vitesse dans le mouvement de la vis d'Archimede fur fon axe, tire des mémoire manuscrits de M. Pingeron, fur les arts utiles et agréables. Journ. d'Agric. Juin. 1780.

The Theory of the Syphon, plainly and methodically illustrated, 1781. (Richardson.)


Différation de M. de Paricius fur le moyen d'élever l'eau par la rotation d'une corde verticale fans in Amsterdam et Paris, 1792.


Nicander's Theorie der spirale pumpe, 1786.

Nicander's Theorie de spiral pumpe, 1790.


Nicander's Theorie der spirale pumpe, 1786.

Nicander's Theorie de spiral pumpe, 1790.

A short account of the invention, theory, and practice of fire-machinery; or introduction to the art of making machines, vulgarly called steam-engines, in order to extract water from mines, convey it to towns, and jets d'eau in gardens, to procure water-falls for fulling, hammering, flanging, rolling, and corn-mills, by William Blakey, 1793.

Egerton.

Machines actuated by the Force of Currents or Streams of Water.—These are very numerous, but all may be reduced to two kinds.

First, those which are adapted to receive the impulse of moving water; that is, water which has been put in motion in consequence of a defcent towards the earth previously to its operating on the machine, which must be provided with parts proper to refit and take away some of the motion of such water, and it will thereby receive motion which may be applied to produce some mechanical effect. Of this kind are the underwater and horizontal water-wheels.

Secondly, those machines which are provided with some kinds of buckets or vessels to contain water, the weight of which buckets, and the water they contain, is supported by the machine, so that the water cannot defcent towards the earth in consequence of its gravitation, without giving motion to the buckets or vessels which contain and support it. Of this kind is the over-shot water-wheel, breast-wheel, chain of buckets, and prelTure-engine.

In either case, the motive force or power is the same; viz. the gravitation and motion of such bodies or masses of water as are found more elevated above the surface of the earth than the general level of the sea, or of some other water in its neighbourhood; such water will defcent by the force of gravity until it joins the sea, or until it is supported or held up by some fixed obstacle.

The difference between the two kinds of machines is, that in the first case the water is suffered to defcent before it operates upon the machine, and in consequence of its gravitation, acquires motion with a velocity proportioned to the space through which it has defcented; and the office of the machine is to take from the moving water as much of its compounded weight and motion, or power, as it can obtain.

In the other case, the machine receives its motion and power at the same time, when the water acquires it, by de- scending; or, in other words, the machine moves with the water.

The word power, as used in practical mechanics, signifies the exertion of strength, gravitation, impulse, or prelTure, so as to produce motion; and a machine actuated by means of strength, gravitation, impulse, or prelTure, compounded with motion, is capable of producing an effect; and no effect is properly mechanical but what requires such a kind of power to produce it.

The muscular power of animals, as likewise prelTure, im- pact, gravitation, electricity, &c. are looked upon as forces, or sources of motion; for it is an incontrovertible fact that bodies exposed to the free action of either of these are put in motion, or have the state of their motion changed. All forces, however various, can be measured by the effects they produce in like circumstances; whether the effects be creating, accelerating, retarding, or defleting motions: the effect of some general and commonly observed force is taken as unity.

The most proper measure of power is the act of raising some weight with some velocity of motion; that is, the overcoming of the gravitating force of a weight in such degree as to produce motion in opposition to gravity. In confidering the quantum, the weight or malls of matter operated upon must be one quantity, and the velocity of the motion communicated is the other; the mechanical power is
WATER.

the compound of both. We can only measure the weight of any body or mass of matter by its relation to some other weight with which we are acquainted; hence we say, the weight is equal to so many pounds, or so many cubic feet of water. In like manner, we measure the velocity or intensity of the motion, by stating the height or perpendicular distance from the earth, (measured by relation to some known distance, as a foot or a yard,) through which height the weight is raised in some known space of time, as a second or a minute.

For instance, 528 cubic feet of water is a known weight or mass of water; let a machine operate upon this, and raise it upwards, through the space of one foot in the time of one minute; then $528 \times 1 \times 1 = 528$ is the number which represents the power which the machine exerts. Suppose another machine to operate on 132 cubic feet of water, and raise it four feet in one minute, then using the same measures to determine the quantities of weight, height, and time, we say $132 \times 4 \times 1 = 528$; hence these two machines are equal in the power which they exert; for in all cases the weight raised is to be multiplied by the height to which it can be raised in a given time, and the product is the measure of the power expended in raising it; consequently, all those powers are equal whose products made, by such multiplication, are equal; for example, take two powers, if one can in any given time raise twice the weight to the same height, or the same weight to twice the height, in the same time that the other power can, the first power is double the second; or, if one power can raise half the weight to double the height, or double the weight to half the height, in the same time that another can, those two powers are equal: but note, all this is to be understood only in cases of slow or equal motion of the body raised, for in quick, accelerated, or retarded motions, the vis inerter of the matter moved will make a variation.

The machines actuated by the impulse of flowing water are, the underbot water-wheel, horizontal wheels, and Mr. Barker's mill. It is a common expression to call all wheels in which the water runs or floats under the wheel, underbot; but in this place we shall only speak of Underbot Water-Wheels acting by the Impulse of flowing Water.—These are the most ancient and original forms of water-machines, although if they had been invented from the result of reasoning, such as we have given, they would have been the last, because their manner of action is least obvious; but this was not the case. The first machines were wheels placed in a river or running stream, and provided with vanes or wings on the circumference, called floats; the floats at the lower part of the wheel, dipped into the stream to intercept the water. When the plane of the floats became perpendicular to the direction of the current, or nearly so, they would resist or oppose the motion of the water, and the wheel would obtain motion from it in proportion to the quantity of motion, its floats abstracted from the water of the stream. The power thus obtained would be found to be only a small proportion of the power of the stream, because the water would easily escape sideways from the floats, particularly if it were attempted to take away any considerable share of the velocity of the water, by refitting or loading the wheel, so as to make it move slowly. Hence it became an obvious improvement to contrive the river to the exact size of the float-boards of the wheel, or to make a close channel in which the wheel exactly fits. The next improvement would be to intercept the river or stream of water by a dam, or obstacle, in order to make it pen up, or accumulate, till it had risen to the greatest height which could be obtained, and to let the water out of the dam or reeover into the channel or wheel-courfe, through a vertical aperture or door, level with the bottom of the wheel-courfe; in this way, the water would be urged by the pressure of the water in the dam, and would rush out from the aperture in a stream or spout, with a velocity proportioned to the perpendicular pressure, and would strike the float-boards of the wheel so as to urge them forwards. Such is the form of the underbot wheels still generally employed in France and on the continent; but in England they have been long superseded by more effectual applications of the power of the water, and it is very rarely we meet with an underbot wheel acting by the impulse of the water. They are called ground-shot wheels, because the water runs or floats along the ground or floor of the channels in which the wheels work.

It was first proved by Mr. Smeaton, in 1754, that only a portion of the power of any fall of water could be obtained by means of an underbot wheel; for M. Belidor had not long before flated the underbot wheel as the best mode of applying a fall of water. It was one of the continual occupations of Mr. Smeaton, during forty years, to improve the old water-mills, by substituting breast-wheels for underbot; and the advantages were uniformly so great, that these mills were copied by others, until scarcely any of the original construction remained. We do not mean that Mr. Smeaton invented the breast-wheel, for it is described by Leopold; but he first investigated its comparative advantages.

It is from this circumstance that we find, in all the mechanical writings of foreign authors, much more mathematical investigation relative to the underbot water-wheels than the importance of the subject deserves, and we shall dismiss it more briefly.

The excellent paper by Mr. Smeaton, in the Philosophical Transactions for 1759, contains a numerous list of experiments most judiciously contrived by him, and executed with the accuracy and attention to the most important circumstances which are to be observed in all that gentleman's performances.

Mr. Smeaton's rules were originally deduced from experiments made on working models, which are the best means of obtaining the outlines in mechanical enquiries; but in every case it is necessary to distinguish the circumstances in which a model differs from a machine at large, otherwise a model is more apt to lead from truth than towards it; and we must not, without great caution, transfer the results of such experiments to large works. But we may safely transfer the laws of variation, which result from a variation of circumstances, although we must not adopt the absolute quantities of the variations themselves. Mr. Smeaton was fully aware of the limitations to which conclusions drawn from experiments on models are subject, and has made the applications with his usual sagacity. The best structure of machines cannot be fully ascertained but by making trials with them, when made of their proper size.

Mr. Smeaton's Principles for Underbot Wheels.—In comparing the effect produced by water-wheels with the powers producing them; or, in other words, to know what part of the original power is necessarily lost in the application, we must previously know how much of the power is spent in overcoming the friction of the machinery, and the resistance of the air; also, what is the real velocity of the water at the instant it strikes the wheel; and the real quantity of water expended in a given time.

The velocity Mr. Smeaton measured in a most satisfactory manner in every experiment, by applying a cord and weight to the axle of the wheel, not to wind up the weight by the motion.
motion of the wheel, but that the weight by defcending
should turn the wheel. He applied so much weight as would
make the wheel turn, and make its floats move with the ve-
locity which he defired or expected the effluent water to
have; and this weight he adjusted until he found, by re-
peated trials, that the wheel moved just at the fame rate,
whether the water was suffered to flow and strike its floats, or
whether the water was stopped, which proved that the floats
of the wheel moved with precisely the fame velocity as the
effluent water; then by measuring the circumference of the
wheel, and counting the number of turns it made in a mi-
ute, he obtained the measure of the velocity.

From the velocity of the water at the instant that it
strikes the wheel, the height of head productive of such
velocity can be deduced from acknowledged and experi-
mented principles of hydrostatics; fo that by multiplying
the quantity or weight of water really expended in a given
time by the height of head so obtained, which must be
considered as the effective height from which that weight
of water had descended in that given time, we shall have a pro-
duct equal to the original power of the water, and clear of
all uncertainty that would arise from the friction of the water
in paffing small apertures, and from all doubts arising from
the different measure of spouting waters, affigned by dif-
ferent authors.

On the other hand, the sum of the weights railed by the
action of this water, and of the weight required to over-
come the friction and refiftance of the machine, multiplied
by the height to which the weight can be railed in the time
given, the product will be equal to the effect of that
power; and the proportion of the two products will be the
proportion of the power to the effect: fo that by loading
the wheel with different weights successively, we shall be
able to determine at what particular load and velocity of the
wheel the effect is a maximum.

From experiments conducted in this manner, Mr. Smea-
ton fettled the following maxim:

Maxim 1. That the virtual or effective head of water, and
consequently its effluent velocity being the fame, the mecha-
nical effect produced by a wheel actuated by this water will
be nearly in proportion to the quantity of water expended.

Note. The virtual or effective head of any water which is
moving with a certain velocity, is that height from which a
heavy body must fall in order to acquire the fame velocity.
The height of the virtual head, therefore, may be easily
determined from the velocity of the water; for the heights
are as the square of the velocities; and the velocities, con-
sequently, as the square roots of the heights. Mr. Smea-
ton observed the velocity of the effluent water in all his ex-
periments, and thence calculated the virtual head; he finds
that the virtual head bears no proportion to the real head or
depth of water; but that when either the aperture is greater,
or when the velocity of the water infuies thencefrom
lefs, they approach nearer to coincidence; and consequently,
in the large openings of mills and fountains, where great quan-
tities of water are discharged from moderate heads, the
actual head of water, and the virtual head, as determined by
theory from the velocity, will nearly agree.

For example of the application of his firft maxim. Sup-
pone a mill driven by a fall of water, whose virtual head is
5 feet, and which discharged 550 cubic feet of water per
minute; and that it is capable of grinding four buhels of
wheat in an hour. Now another mill, having the fame vir-
tual head, but which discharges 1100 cubic feet of water
per minute, will grind eight buhels of corn in an hour.

Maxim 2. That the expence of water being the fame, the
effect produced by an underhot wheel will be nearly in pro-
portion to the height of the virtual or effective head. This
is proved in the preceding example.

Maxim 3. That the quantity of water expended being the
same, the effect will be nearly as the square of the velocity
of the water; that is, if a mill driven by a certain quantity
of water, moving with the velocity of 18 feet per fecound,
is capable of grinding 4 buhels of corn in an hour, another
mill, driven by the fame quantity of water, but moving
with the velocity of 22 2/3 feet per second, will grind nearly
7 buhels of corn in an hour; because the square of 18 is
324, and the square of 22 2/3 is 506 1/3. Now fay, as 324
is to 4 buhels, fo is 506 1/3 to 6 buhels; that is, as 4
to 6.

Maxim 4. The aperture through which the water infuies
being the fame, the effect will be nearly as the cube of the
velocity of the water infuies; that is, if a mill driven by
water rushing through a certain aperture with the velocity
of 18 feet per fecound will grind 4 buhels of corn in an
hour, another mill, driven by water moving through the
fame aperture, but with the velocity of 22 2/3 feet per fecound,
will grind 51 buhels; for the cube of 18 is 5832, and the
cube of 22 2/3 is 11396 1/3; then, as 5832 is to 4, fo is
11396 1/3 to 72.

Maxim 5. The proportions between the power of the water
expended, and the effect produced by the wheel, was 3 to 1.
Upon comparing feveral experiments, Mr. Smeaton fixed the
proportions between them for large works; that is, if the
weight of the water which is expended in any given
time be multiplied by the height of the fall, and if the
weight railed be also multiplied by the height through
which it is railed, the fIrst of these two products will be
three times that of the fSecond.

Maxim 6. The felt general proportions of velocities
between the water and the fIoats of the wheels will be
that of 5 to 2; for instance, if the water when it strikes
the wheel moves with a velocity of eighteen feet per
fecound, the wheel must be so loaded that its float-boats
will move with a velocity of 7-2 feet per fecound, and the
wheel will then derive the greatest power from the water,
because as 5 to 18, fo is 2 to 7-2.

Maxim 7. There is no certain ratio between the load
that the wheel will carry when producing its maximum of ef-
eft, and the load that will totally flop it; but it approaches
nearer to the ratio of 4 to 3, whenever the power exerted
by the wheel is greateft, whether it arises from an in-
crease of the velocity, or from an increased quantity of
water; and this proportion seems to be the moft applicable
to large works. But when we know the effect a wheel
ought to produce, and the velocity it ought to move with
whilft producing that effect, the exact knowledge of the
greatest load it will bear is of very little confluence in
practice.

Maxim 8. The load that the wheel ought to have, in order
to work to the moft advantage, can be always affigned thus:
aftercertaining the power of the whole body of water, by multiply-
ing the weight of the water expended in a minute by the height
of the fall, take one-third of the product, and it gives the
effect of power which the wheel ought to produce; to find
the load, we muft divide this product by the velocity which
the wheel fhould have, and that, as we have before fettled,
should be two-fifths of the velocity with which the water
moves when it strikes the wheel.

The wheel must not be placed in an open river to be ac-
tuated by the natural current, in which cafe, after it has
communicated its impulfe to the float, it has room on all
fides to escape: this is the fuppofition of cafe on which most
mathematicians have proceeded; but in all these experimen-
tests,
ments, the wheel is placed in a conduit or race, to which the float-boards are exactly adapted, and the water cannot otherwise escape than by moving along with the wheel. It is observable in a wheel working in this manner, that as soon as the water meets the float, it receives a sudden check, and rises up against the float, like a wave against a fixed object, insomuch that when the float of water is not a quarter of an inch thick before it meets the float, this float will act upon the whole surface of a flat, whose height is three inches; and consequently, where the float is no higher than the thickness of the float of water, as theory also supposes, a great part of the force would have been lost by the water dashing upon the float.

The wheel which Mr. Smeaton used had originally twenty-four floats, and was afterwards reduced to twelve, which caused a diminution in the effect, on account of a greater quantity of water escaping between the floats and the floor of the channel in which it moved; but a circular sweep being adapted thereto, of such a length, that one float entered the curve before the preceding one quitted it, the effect came so near to the former as not to give hopes of advancing it, by increasing the number of floats beyond twenty-four in this particular wheel.

Mr. Smeaton observes, that, in many of the experiments, the results were by different ratios than those which his maxims supposed; but as the deviations were not very considerable, the greatest being about one-eighth of the quantities in question, and as it is not practicable to make experiments of so compound a nature with absolute precision, he supposes, that the leffer powers are attended with some friction or work under some disadvantages, which have not been duly accounted for; and, therefore, he concludes that these maxims will hold nearly, when applied to works in large.

Application of these Principles to Practice.—The first thing to be done in a situation where an underfoot wheel is intended to be fixed, is to consider whether the water can run off clear from the wheel, so as to have no back water to impede its motion, and whether the fall which can be obtained by constructing a proper dam to pen up the water and cause it to pass through, will cause it to strike the float-boards of the wheel with a sufficient velocity to impel them forcibly forwards; and also, whether the quantity of the supply will be sufficient to keep a wheel at work for a certain number of hours each day.

When we have ascertained the height of the fall of water, that is, the height of the surface above the centre of the opening of the sluice, we must find what will be the continual velocity of the water issuing out from such opening.

In some cases, we have the velocity of the water given when it issues from the opening of the sluice, and we then require to know what height of column will produce that velocity. These two things we may find by a simple rule, and an easy arithmetical operation, which is as follows:

1st. The perpendicular height of the fall of water being given in feet and decimals of feet, the velocity that the water will acquire per second, expressed in feet and decimals, may be found by the following rule:

Multiply the constant number 64,2882 by the given height, and the square root of the product is the velocity required.

Example 1.—If the height is two feet, the velocity will be found 11.34 feet per second.
Example 2.—If the height is 16,0913 feet, the velocity will be 32,1826 feet per second.
Example 3.—If the height is fifty feet, the velocity will be 56,68 feet per second.

Note. The velocities thus obtained will be only the theoretic velocity, that is, the velocity any body would acquire by falling through such height in vacuo, the velocity in reality will be less, generally six or seven-tenths.

The uniform velocity of a fluid being given, expressed in feet and decimals of feet per second, the height of the column or fall to produce such a velocity may be found by the following rule:

Multiply the given velocity into itself, and divide the product by 64,2882; the quotient will be the height required, expressed in feet and decimals.

Example 1. — If the velocity given is three feet per second, the height will be 0.139 of a foot.
Example 2. — If the velocity given is 32,1826 feet per second, the height will be found 16,0913 feet.
Example 3. — Let the velocity be 100 feet per second, the height will be 155,649 feet.

The knowledge of the foregoing particulars is absolutely necessary for constructing an underfoot water-wheel; but the most advantageous method of letting it to work, and to find out the utmost it could perform, would be very difficult, if we were not furnished with the maximum which Mr. Smeaton gave, by shewing, that an underfoot water-wheel will act to the greatest advantage, when the velocity of its float-boards is equal to two-fifths or four-tenths of that of the water which gives it motion.

To illustrate this, let us consider a wheel equally balanced on all sides, and turning freely round upon its pivots, its circumference would soon move as fast as the current it was placed in. Suppose the water to move at the rate of three feet in a second, the circumference of the wheel would pass through three feet in a second. In this case, the wheel performs no work, and the effect produced is nothing.

Now in attempting to apply the power of this wheel to turn any kind of machinery, suppose the work to be so proportioned, that the resistance would cause the wheel to stand still and float the water, or make it run over the floats, in consequence of its not having sufficient force to carry the float-boards along with it. In this case also, there being no motion, there could be no mechanical effect produced; but if the resistance be diminished by degrees, the wheel would begin to partake of the motion of the current of water, being loaded, would produce a mechanical effect proportional to the load and velocity. The wheel would increase in its velocity in proportion as the resistance was diminished, and the mechanical effect would increase also until a certain point when the wheel moved so fast, that the water would not strike the float-boards quick enough to produce the greatest effect: this is found to be as before mentioned, when the floats move four-tenths as fast as the water, because then the water is employed in driving the wheel with a force proportional to the square of its velocity.

If we multiply the surface or area of the opening by the height of the column, we shall ascertain the body or column of water which should press against that float-board, which is immediately under the wheel, supposing it has no motion; but it will be found, that a small proportion of the weight of the original column hung on the opposite side of the wheel, would arrest its motion entirely; but when we would have it to move with a proper velocity, that is, two-fifths of that velocity with which the water moves, 360° of the weight of the original column, is the weight which the wheel would raise with four-tenths of the velocity that the water moves with, and the power which the wheel would exert on the machinery to grind corn, lift hammers, raise water,
WATER.

water, &c. is \( \frac{1}{2} \cdot \text{weight of water multiplied by } \frac{1}{2} \text{ of its velocity.} \)

Thus it appears that an under-shot water-wheel, constructed after the foregoing manner, would only raise one-third part of the water expended to the same height, as the original head or level. This is the utmost that can be expected, though often less is done; because here we suppose every part exactly performed, and the water applied to the wheel in the best manner; therefore, as we cannot come up to the maximum, we must come as near it as we can by losing the least possible of the power's impulse.

It is no advantage to have a very great number of float-boards round the wheel, because when they are struck by the water, as applied in the best manner possible, the sum of the impulses exerted on the different floats, will be but equal to the impulse made against one float-board struck by all the water issuing from the sluice at right angles to its surface. But as this float-board must move forward, there must be a succession of float-boards to receive the impulse of the water, and since they cannot receive it at right angles, there will be some loss of impulse in that succession. Besides when the first float-board is so far past the perpendicular, as to have the action of the water intercepted by the succeeding one, it is checked by the back water through which it must pass in rising out of the water, and thereby be so far retarded as to take from the full effect of the impulse on the following float. Indeed if all the water could run off immediately after having performed its office, this would not happen; but it can seldom be effected in under-shot mills, especially those built upon rivers. All the remedy in such cases is, (when the diameter of the wheel is settled) to fix just such a number of floats upon it, that each one, after it has received the full impulse of the water, may come out of the water as soon as possible, that another succeeding float may be brought to receive the impulse, otherwise the wheel would remain a moment without any impulse.

In the article Mill we have given a table for the dimensions and proportions for under-shot wheels, which was calculated by Mr. Fergason. Dr. Brewster, in his new edition of Mr. Fergason's works, has given an improved table, which is calculated upon the following principles.

It is evident that the water-wheel must always move with less velocity than the water, even when there is no work to be performed; for a part of the impelling power is necessarily spent in overcoming the inertia of the wheel itself; and if the wheel has little or no velocity, it is equally manifest that it will produce a very small effect.

There is consequently a certain proportion between the velocity of the water and the wheel, when the effect is a maximum. Mr. Smeaton has shown the greatest effect is produced when the velocity of the wheel is between one-third and one-half, but the maximum is much nearer to one-half than one-third. He observes also that one-half would be the true maximum, if nothing were lost by the refraction of the air, the scattering of the water carried up by the wheel, and thrown off by the centrifugal force, and the leakages of the water between the floats and the water-courfe, all which tend to produce a greater diminution of the effect at that velocity, which would be the maximum if these losses did not take place, than they do when the motion is a little flower. The great hydraulic machine at Marly, the wheels of which are under-shot, was found to produce a maximum effect when the velocity of the wheel was two-fifths that of the current. Hence Dr. Brewster concludes that in theory the velocity of the wheel is one-half that of the current, and that in practice it is never more than three-eighths of the stream's velocity, when the effect is a maximum.

Dr. Brewster's Table of under-shot Water-Wheels, in which the velocity of the wheel is three-fourths of the velocity of the water, and the effects of friction on the velocity of the stream are reduced to computation. The wheel is supposed to be fifteen feet diameter.

<table>
<thead>
<tr>
<th>Height of the Fall of Water</th>
<th>Velocity of the Water per Second, Friction being considered</th>
<th>Velocity of the Wheel per Second being three-fourths that of the Water</th>
<th>Revolutions of the Wheel per Minute, its Diameter being fifteen Feet</th>
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<td>34.17</td>
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Another Manner of applying Water to an under-shot Wheel.

This was proposed by M. Fabre as the result of much mathematical investigation, and has been so frequently recommended by authors of eminence, that we shall give a short description without entering into all his rules for the proportions. The principal difference in this wheel from that in common use is, that the water is made to run down a rapid slope or inclined plane, in order to strike the floats of the wheel, instead of issuing from an aperture or sluice situated beneath the surface of the water in the refervoir. A mill is usually situated at a distance from the river, with a canal or water-courfe to conduct the water to the mill; as it is of the highest importance to have the height of the fall as great as possible, the bottom of the canal or water-courfe, which conducts the water from the river to the mill, should have a very small declivity; for the height of the water-fall at the mill will diminish in proportion as the declivity of the canal is increased: it will be sufficient to make it slope about one inch in 200 yards, taking care to make the declivity about half an inch in the first 48 yards, in order that the water may have a velocity sufficient to prevent it from flowing back into the river.

When the water is thus brought to the channel in which the wheel is placed, the water is recommended to be conducted down a slope or inclined plane, making an angle of 62° degrees with the horizon; that is, in a perpendicular of ten feet, the slope should deviate from it 4°. When the water is to be again conducted horizontally, and then to strike the float-boards of the wheel.
WATER.

wheel. To render the fall of the water easy, the slope is to be rounded off by a convexity at top and a concavity at bottom, to lead the water from the horizontal to the slope, and again from the slope without abruptness. It is supposed that the water, in running down this inclined plane, will acquire the same velocity as if it had fallen perpendicularly through a height equal to the perpendicular height of the slope.

The distance through which the water runs horizontally, from the foot of the slope before it acts upon the wheel, should not be less than two or three feet, in order that the different portions of the fluid may have obtained an horizontal direction; but if this horizontal distance be much larger, the velocity of the stream would be diminished by its friction on the bottom and sides of the water-courbe. That lets water may escape between float-boards and the bottom of the course, it should be formed into the arch of a circle concentric with the wheel, which sweep should be prolonged, so as to support the water as long as it can act upon the float-boards; beyond this sweep should be a step or fall of not much less than nine inches with a slope of about 45 degrees, that the water having spent the greater part of its force in impelling the float-boards, may not accumulate below the wheel and retard its motion. After this step the course of discharge, or tail water-courbe to run off the water from the wheel, should be floored with wood or marble about 16 yards long, having an inch of declivity in every two yards.

The canal which conducts the water from the course of discharge to join the river again, should slope about four inches in the first 200 yards, and three inches in the second 200 yards, and so decreasing gradually till it terminates in the river. But if the river to which the water is conveyed, should be subject to be swelled by the rains, so as to force the water back upon the wheel, the canal must have a greater declivity, in order to prevent this from taking place. Hence it will be evident, that very accurate levelling is necessary for the proper formation of the mill-courbe. The tail-water-courbe ought always to have a very considerable breadth, which should be greater than that of the wheel-race, or part in which the wheel acts, that the water having room to spread may have less depth. The section of the fluid at the point where it strikes the wheel should be rectangular, the breadth of the stream having a determinate relation to its depth. If there is a great stream of water, the breadth should be triple the depth; if there is a moderate quantity, the breadth should be double the depth; and if there is very little water, the breadth and the depth should be equal. The depth of the water here alluded to is its natural depth, or that which it would have, if it did not meet the float-boards. The effective depth is generally two and a half times the natural depth, and is occasioned by the impulse of the water on the float-boards, which forces it to swell, and increases its action upon the wheel.

As it is of great consequence that none of the water should escape, either below the float-boards or at their sides, without contributing to turn the wheel, the breadth of the float-boards should be wider than the sheet of water which strikes them. The diameter of the water-wheel should be as great as possible, unless some particular circumstances in the construction prevent it; but ought never to be less than seven times the natural depth of the stream or thickness of the sheet of water, where it meets the float-boards. The wheel will move irregularly, sometimes quick and sometimes slow, according to the position of the float with respect to the stream; unless the number of float-boards is considerable, the wheel must have so many floats, that two floats will at least be always in the circular sweep at the bottom of the wheel; but in order to remove any inequality of motion in the wheel, and prevent the water from escaping beneath the tips of the float-boards, it should have as many float-boards as possible, without loading it, or weakening the rim on which they are placed. The float-boards should not be perpendicular to the rim; or, in other words, a continuation of the radius, but should be inclined to the radius; the water will thus leap upon the float-boards, and act not only by its impulse, but also by its weight. When the velocity of the stream is eleven feet per second, or above this, the inclination should never be less than thirty degrees; or when this velocity is less, the inclination should diminish in proportion; so that when it is four feet, or under, the inclination should be nothing, that is, the float-boards should point to the centre of the wheel.

It is a strong practical objection to this manner of applying the water to the wheel, that when the water of the river sinks in dry weather from a deficiency of water, it would not run over the top of the fall, and the mill could not work at all even if it sunk only ten or twelve inches: in like manner, when the water rises in floods, the water at the top of the fall would become too deep, as to require some fluttié to prevent it from inundating the wheels, at the same time that the stagnant water in the mill-race would prevent the wheel from working. Almost all rivers are subject to floods, and often they rise and fall, three, four, five, and eight feet above their ordinary level in fair weather; now the water molly rises at the tail or discharge of the water as much as the head, and the wheel-race will therefore be full of stagnant water, which is called tail-water, and obstructs the motion of the wheel.

In a ground-flat wheel, where the water issues from a shuttle on a level with the bottom of the wheel-race, it can always work in dry seasons, as long as the river contains any water, although the power diminishes almost to nothing, when the water sinks low, and will not rush out with force from the shuttle. In floods of water, this wheel has a greater advantage, because the depth of head which urges the flowing water is increased when the water is high, and this makes it drive the tail-water forcibly out of the wheel-race, and enable the wheel to work, when a wheel with an inclined fall would infallibly be stopped.

Breast-wheels and over-shot wheels, properly constructed, have still greater advantages, in clearing themselves from tail-water, and this is a very important object.

Floating-Mill with Under-shot Wheels.—A large floating water-mill, to be worked by the tides or currents, was stationary some years ago in the river Thames, between London and Blackfriars bridge, by permission of the Board of Navigation. Such permission having been granted with the view of reducing, if possible, the price of flour in the metropolis, and contributing to a constant supply of that necessary article of subsistence. The simplicity of this invention renders a long description superfluous, as it consists in merely applying the force of two large under-shot water-wheels on each side of a barrage, or any other vessel calculated to contain the interior part of the machinery; the float-boards are disposed in a proper manner to be acted on by the tide or current, so as to give the wheels a rotatory motion, and by connecting them with proper machinery, to answer the purposes for which the mill is intended.

Any ship, brig, sloop, or other vessel, may be used for this purpose, provided it is of sufficient size to accommodate the works to be erected, yet in point of expense it will be better to employ such as are rendered unfit for service.
When it is intended that the ship or mill should be stationery, it must be anchored, moored, or otherwise made fast, so as to lie with the tide when necessary; but the mill may be worked while the vessel in which it is erected is sailing, when wind and other circumstances permit.

The number and size of the water-wheels to be used may be varied, according to the size of the ship or vessel, or to the strength of the tide or current, and the power required; and the wheels may be constructed as in common under-shot mills, or with folding-floats, for the more readily freeing them from the water: two wheels are to be placed vertically, on an horizontal axis, of such length, that, the axis being placed across the ship or vessel, one wheel may run on each side of it on the same axis.

A mill constructed in the manner above described may be moved by the strength of from two to fix large water-wheels, or such other number as the ship or vessel will accommodate. These water-wheels may dip into the water from three to four, or more feet deep; they should be so connected together as to be easily engaged with and disengaged from each other, so that during the weak part of the tide they may all be made to act on one pair of mill-stones, if necessary; and as the strength of the tide increases, more stones or other machinery may be put in motion, so as at all times to do business in proportion thereto.

In a mill of this kind the water-wheels do not admit of having water-courses, or any equivalent contrivances, to conduct the water to the wheels, as in other under-shot mills; but the float-boards must be large enough to receive the power required from merely dipping into the current of the tide-water.

The vessel of the mill in the Thames is the hull of an old ship of two or three hundred tons burthen, which being moored in the river by chains, so that it can swing round when the tide changes, the wheels will always turn the same way round; one water-wheel is fixed on each side of the vessel, a long iron axis being common to both: the extreme ends of the axis are supported in a frame work of timber, and another very strong frame of timber is fixed outside of the wheels at the level of the water, which floats in the water, and is only attached to the mill by chains; this is to protect the wheels from injury, by vessels which pass and repass. Each water-wheel is 18 feet diameter, and 14 feet broad: the float-boards are each 3 feet deep, and are about fifteen in number, affixed on the circumference of cart-iron-wheels, or circles, which are 12 feet diameter, there are three of these circles for each wheel; hence we find each float-board exposes a surface of 42 square feet to the action of the current; and if we suppose each wheel to have two floats in action at the same time, the power of the mill will be derived from 168 square feet acted upon by the water, which feldom exceeds a velocity of four miles per hour, or 352 feet per minute.

The iron axis of the water-wheels is a hollow tube of nine inches diameter outside, and five inches within, made in four lengths of 12 feet each, properly joined together, and extending across the vessel from one wheel to the other. On the middle of this axis a large wheel of 11 feet diameter is fixed, and surrounded by a brake or grippe like that used in a wind-mill, the use of which is to stop the mill when it requires repairing. Near to this brake-wheel is a large be-villed cog-wheel 14 feet diameter, with 89 cogs, which gives motion to a be-villed pinion two feet eight inches diameter, with eighteen cogs fixed on the top of a vertical axis. On this axis is also a large horizontal spur-wheel 12 feet diameter, with 201 cogs, which gives motion to pinions of one foot diameter, and 17 cogs fixed on the spindles of the mill-stones. There are four pair of mill-stones, two pair of 4½ feet and two pair of 3½ feet diameter, and the mill also works a dressing-machine for the flour. The mill-stones make 57½ revolutions for one revolution of the water-wheels, which move very slow, scarcely two turns per minute, in the most favourable periods of the tide. The circumference of each taken through the middle of the float-boards is 47 feet; hence the float-boards move about 94 feet per minute, when the mill-stones make their proper number of revolutions to grind with the greatest effect.

It was found that on a flood-tide, this mill would drive two pair of 3½ feet mill-stones, and a flour dressing-machine, but on the ebb-tide only one pair of 4-feet stones and the machine; thus it is only the performance of a small mill, although the wheels are of large dimensions, and it would require enormous wheels to make an effective floating mill in the river Thames.

This machine is now removed from the river, because it was found to do much injury to the vessels which continually ran against its floating frame, and the repairs of the damages frequently done to the mill by ice and the craft took away all the advantages of the mill.

Under-float Wheels with oblique Floats.—Attempts have been made to construct water-wheels for tide-rivers which receive the impulsive obliquely, like the falls of a common wind-mill. This would in many situations be a great advantage. A very slow but deep river could in this manner be made to drive mills; and although much power would be lost by the obliquity of the impulsion, the remainder might be very great. Dr. Robinson speaks of a wheel of this kind which was very powerful; it was a long cylindrical frame, having a plate standing out from it about a foot broad, and surrounding it with a very oblique spiral like a cork-screw. This was immersed about one-fourth of its diameter (which was nearly 12 feet), having its axis in the direction of the stream. By the work which it was performing, it seemed more powerful than a common wheel which occupied the same breadth of the river. Its length was not less than 20 feet; had it been twice as much it would have been nearly redoubled in its power without occupying more of the water-way. It is probable such a spiral continued quite to the axis, and moving in a hollow canal wholly filled by the stream, might be a very advantageous way of employing a deep and slow current.

In the transactions of the Society of Arts, vol. xix. a water-wheel is described, in which the float-boards are placed obliquely to the axis of the water-wheel at about an angle of 40 degrees, being fixed to the rim in pairs, which are inclined equally to the axis of the wheel, but in opposite directions to each other; so that the two float-boards of each pair point towards each other in an angle of about 80 degrees, and if the pair of floats were continued they would meet in the middle of the breadth of the wheel. The water is made to strike the floats within this angle, and in consequence all the water which is emitted by the sluice and strikes upon the oblique floats will be reflected from the sides or ends of the two pair of float-boards towards the vertex of the angle, which they make; but the pair of floats do not touch each other, so that the vertex of the angle is open; but to prevent the water palling freely through the open angle, one of the float-boards is made to extend far beyond the vertex, or point, where they would intersect, and the other is made to fall short of it, nevertheless the water would certainly pass through the opening. It is stated, that the motion of the ordinary wheel with parallel floats is greatly retarded by the resistance which they experience in rising or quitting the tail-water of the stream, from the pressure
preasure of the atmosphere on their upper surface before the
air gets admission beneath the floats; but in Baffian's wheel
this refliance is greatly diminished, as the floats emerge from
the stream in an oblique direction. The water-wheel is
constructed in the form of a hollow drum, so as to refiit the
admission of the water. Although this wheel is much heav-
er than those of the common construction, yet it revolves
more easily upon its axis, as the stream has a tendency to
make it float. We cannot recommend this wheel, but on
the contrary think it one of the worst forms, as it tends to
increase that lofs which arises in all underflot-wheels from
the change of figure which the water must undergo when it
strikes the float, and we should not have mentioned it, but
that it has been so frequently copied and recommended by
different authors.

**Horizontal Water-wheels actuated by the Impulse of Water.** —

These have been considerabiy in use on the continent, and
deferve our notice from the simplicity of their conftuction.
The wheel is constructed in the fame manner as an under-
flot-wheel, having float-boards fixed round its circumference
in the form of radii; it is mounted on a vertical axis, the
upper end of which is fixed to the fpindle of the mill-flone,
if the mill is intended to grind corn; but in some cafes, it is
better to fix a cog-wheel on the upper part of the vertical
axis with teeth round its edge, to give motion to trundles
or pinions on the fpindles of the mill-flones, because the
floats of the wheel must always be made to move with a
given proportion of the velocity of the water. The wheel-
race or water-course may be made nearly the fame as for an
underflot-wheel, if we fuppofe it laid down in an horizontal
position; that is, a trough or channel of mafonry is con-
flucted in which the wheel works, and the float-boards of
the wheel are exactly fitted to it; at one end of this chan-
nel is the aperture or sluice through which the stream of
water iflues, and strikes the floats of the wheel fo as to
turn it round, and the water paffes forwards and efcapees at
the other end of the channel. When the water is delivered
upon the wheel in an horizontal direction, or perpendicular to
its axis, the float-boards fhould be inclinded about twenty-five
degrees to the plane of the wheel, and the fame number of
degrees to the radius, fo that the loweft and outermost flides
of the float-boards may be farthest up the stream and be met
by the water firft.

In many cafes, the water-course is made inclinded to the
plane of the wheel in fuch a degree, that the water may ftrike
the float-boards perpendicular to their surfaces.

In the southern provinces of France, where horizontal
water-wheels are generally employed, the float-boards are
made of a curvilinear form fo as to be concave towards the
stream; they are generally segments of spheres, or hollow
wooden bowls or ladles fixed on the rim of the wheel; the
water, in this cafe, is conducted through a pipe, and pro-
jects in a jet on a direction a little inclinded to the horizon.
When the height of water is very confiderable, this is,
perhaps, the belt form for the floats, or ladles, as they are
called.

The chevalier de Borda obferves, that in theory a double
effect is produced when the float-boards are concave, but that
the effect is diminished in practice, from the difficulty of making
the fluid enter, and leave the curve in a proper direction.
Notwithstanding this difficulty, however, and other defects
which might be pointed out, horizontal wheels with con-
cave float-boards are always superior to thofe in which the
float-boards have plane furfaces.

Mr. Smaleton contructed a small corn-mill with a hori-
zontal water-wheel, of which the following are the prin-
cipal dimenfions. Fall of water $52\frac{1}{2}$ feet; diameter, or

Bore of the nose-pipe through which the water ifflues in
a jet to ftrike upon the wheel, 13 inch; diameter of the
water-wheel to feet to the centre of the floats or ladles,
which were twelve in number; they were made of a con-
cave form, nearly segments of spheres, and about 14 inches
in diameter; and fixed round the circumference of the wheel,
fo that the planes of the circular rims, or edges of the
hollow ladles, were not perpendicular to the plane of the
wheel, but inclined thereto in fuch a degree, that the jet of
water ifflues from the nose-pipe at an angle of 22 degrees
from the horizontal line, would ftrike the float of the centre
and perpendicular to the circular edge of the hollow; the
internal furface of the floats being really spherical, the water
would alwajs ftrike perpendicularly into the concavity of
the bowl. The water-wheel axis rose up perpendicularly
into the mill-house, and on the top a wheel of 4 feet 8 inches
in diameter, and 44 cogs, was fixed for giving motion to
the pinions on the axis of the mill-flones. The large pinion
of 17 cogs was fixed on the axis of a pair of flones 4 feet
6 inches in diameter, and the smaller pinion of 13 cogs on
the axis of a flone 3 feet 6 inches in diameter. It was
not intended to turn both these pairs of flones at the fame
time, but it was neceffary to have two pairs for different
ufes.

When this mill moved with a proper velocity to grind
to the greateft advantage, if the 4 feet 6 inches flones were
used, the water-wheel made 25 revolutions per minute, and
the flones therefore made 65 revolutions per minute, and
the float-boards moved with a velocity of 784 feet per min-
ute; but when turning the smaller mill-flones of 3 feet
6 inches diameter, the water-wheel went belt when it made
26 revolutions, and therefore turned the mill-flone 88 turns
per minute; and the velocity of the floats was 816 feet per
minute.

Mr. Smaleton calculated the velocity of the water ifflues
from the pipe at 3403 feet per minute, which is the velocity due
to a 50 feet feet, because he allowed the 25 feet to overcome
friction, and the expenditure of the 1 inch nozzle-pipe at 30
cubic feet per minute allowing for friction. This mill ground
one bufliel of wheat per hour, on the average of a great
many experiments, now $30 \times 50 = 1500$ cubic feet, falling
one foot per minute. It is found by repeated experiments,
that 600 cubic feet falling one foot per minute on a good
water-wheel is an ample allowance for grinding a bufliel of
wheat, as it may be done by 530; hence this fall of water
ought to have ground 25 bufhiels per hour instead of one.
The mill, however, admits of improvement in making the
floats of the wheel move quicker.

When the mill-flone of an horizontal mill is fixed on the
upper end of the axis of the water-wheel, if the mill-flone be
five feet in diameter, it should never make less than sixty
turns in a minute, and the wheel will perform the fame number
of revolutions in the fame time; and in order that the
effect may be a maximum, or the greatest possible, the vel-
ocity of the current must be more than double that of the
wheel.

Suppofe the mill-flone, for example, to be 5 feet di-
meter, and the water-wheel 7 feet, it is evident that the
mill-flone and wheel must at least revolve 68 times in a mi-
ute; and since the circumference of the wheel is 22 feet,
the float-boards will move through that space in the 6th
part of a minute, that is, at the rate of 22 feet per second;
which being doubled, makes the velocity of the water
44 feet one second, anfwering, as appears from the rule,
for the velocity of falling water, to a fall of 30 feet. But
if the given fall of water be less than 30 feet, we may
procure the fame velocity to the mill-flone, by diminish-

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ing the diameter of the wheel. If the wheel, for instance, is only 6 feet diameter, its circumference will be 18.8 feet, and its floats will move at the rate of 18.8 feet in a second, the double of which is 37.6 feet per second, which answers to a head of water 22 feet high. The diameter of the water-wheel, however, should never be less than 6 or 7 feet, because the float-boards change their direction so rapidly, in consequence of their proximity to the centre, that they will not receive the full action of the water, because it acts in a perpendicular direction to the float-board only for a moment. Hence there will be a certain height of the fall, beneath which the simple horizontal wheel cannot be employed; and beyond that, wheel-work must be introduced to obtain the requisite velocity for the millstones.

In the provinces of Guienne and Languedoc, in France, another species of horizontal wheel is employed for turning machinery. It consists of an inverted cone, with spiral float-boards of a curvilinear form winding round its surface. The wheel moves on a vertical axis in a pit or well of masonry, to which it is exactly fitted, like a coffee-mill in its box. It is driven chiefly by the impulse of the water, conveyed by a spout or canal in a stream, which strikes the oblique float-boards; and when the water has spent its impulsive force, it descends along the spiral float-boards, and continues to act by its weight till it reaches the bottom, where it is carried off by a canal. The idea of this machine is ingenious. The jet of water, being first applied to the upper or largest part of the cone, strikes the float-boards at the part where they move with the greatest velocity, in consequence of their being on the largest radius; but as the water loses its velocity, in consequence of the motion it has imparted to the wheel, it descends in the cone, and acts upon the floats lower down, where, the radius being less, the floats move more slowly, and are therefore better adapted to receive the action of the water with its diminished velocity.

M. Mannoury's Horizontal Water-Wheel, which be calls Danaico.—This receives the impulse of the water in a different manner from any which we have described, and is described in a report to the Institute of France in 1813. The water-wheel is fixed in a horizontal position upon a vertical axis, and supported upon the pivots thereof, so as to be capable of turning round. It is not in reality a wheel, but a hollow cylinder or drum capable of containing water; it is open at top, and united to the axis in the centre of the circular plane, which forms the bottom. Within this drum, and concentric with it, a solid cylinder is fixed; it is of less dimensions than the drum itself, and occupies such portion of the content of the drum as to reduce the open part which can contain water to a hollow ring or circular trough, open at top, and of a considerable depth, but only a few inches in width. The depth is described as being nearly as great as the diameter of the wheel.

The water coming from an elevated reservoir, is projected in jets from one or more pipes into this annular space which surrounds the rim of the wheel. These pipes descend in an inclined direction, till they are nearly on a level with the surface of the water in the annular space; and the extremities turn horizontally, so as to project the jet horizontally, and in the direction of tangents to the mean circumference of the water contained in the annular space.

Suppose this space which surrounds the wheel is full of water, then the stream issuing from the jet causes the wheel to turn round upon its axis, because it takes hold or acts upon the water in the annular space, and tends to give the water a circulating motion within the annular space; but the friction, or resistance, which the water would find in such circulation, caueth the wheel to turn round with the water, unless the load on the wheel, or resistance to its motion, is too great.

The water which is continually thrown into the wheel escapes from the annular space by passages which proceed from the bottom thereof to the centre of the wheel; and there are openings at the centre, where the water can drop out below. To form the passages for this purpose, the solid cylinder which is fixed in the centre of the hollow drum is of less depth than the other, and leaves a space between the bottom of the solid and the bottom of the hollow, which is divided into compartments by diaphragms fixed upon the bottom of the trough, and proceeding like radii from the circumference to a central hole in the bottom of the trough, which is left open to allow the water to escape. The report states, that the velocity with which the water issues from the jets makes the machine move round its axis; and this motion accelerates by degrees, till the velocity of the water in the annular space equals that of the water from the reservoir, so that no sensible shock is perceived of the affinited water upon that which is contained in the machine. The motion of the wheel is regular, because the action is continual; but in the case of other water-wheels, where the water strikes against float-boards, such boards must necessarily be of a determinate number, and the motion must be given to the wheel by a succession of impulses, as the floats arrive before the stream. We might indeed suppose a wheel with an infinite number of floats, but it would then amount to a plain cylindrical or flat surface, upon which the water would not take sufficient hold to produce any sensible effort to turn it round.

Now in M. Dedot's wheel, in place of float-boards, the rim of the wheel is clothed with water, which is capable of being acted upon by the water issuing from the jets. This action tends to put the water in the annular space in motion, and to carry the wheel along with it, by the adhesion it must naturally have to the sides of the channel which contains it. The velocity of the wheel will be in proportion to the resistance that the load makes to its motion.

The circular motion of the wheel communicates a centrifugal force to the water contained in the annular cavity of its rim, which causes it to press against the outermost side of the channel. This centrifugal force acts equally upon the water contained in the compartments at the bottom of the said rim; but its action diminishes as the water approaches the centre.

The whole mass of water is then animated by two opposite forces, viz. gravity and the centrifugal force. The first tends to make the water run out at the hole in the bottom of the wheel at the centre, and the second to drive the water from that hole.

To these two actions are joined a third, viz. friction or resistance, which acts an important and singular part; and in this machine the friction of the water produces its powers of action, while in most other machines it always diminishes their powers. The effect in this machine would be nothing, were it not for the resistance which the water finds opposed to its free circulation in the annular space round the rim of the wheel.

By the combination of these three forces there ought to result a more or less rapid flow of water from the hole in the centre at the bottom of the wheel; and the slower this water issues, the greater will be the effective power of the machine for producing the useful effect for which it is designed.

The moving power in this machine, like all others, is the weight of the water which runs into the wheel, multiplied by
by the elevation the reservoir has above the bottom of the wheel, or orifice from which it issues in quitting the fame; but the useful mechanical effect is flated to be equal to that product, diminished by half the force which the water retains, when it flows out at the orifice below, and quits the machine. In order to ascertain, by direct experiment, the magnitude of this eftect, Mr. Prony and Cannoft fixed a cord to the axis of the machine, which paffing over a pulley, raised a weight by the motion of the machine. By this means the effect was found to be \( \frac{1}{4} \) ths of the power, and often approached \( \frac{1}{3} \) ths, without reckoning the friction of the pulleys, which has nothing to do with the eflect.

We cannot help fuppofting fome fmall error in these experiments, or in the statement of them, but think the machine deferves a trial; and if it fhould produce near the reftult above fated, it would be a moft valuable addition to our means of employing falls of water; and its fimplicity would be a great recommendation, particularly for corn-mills, because the perpendicular axis is immediately adapted for that purpofe, without any wheel-work.

**Horizontal Mill with oblique Vanes.**—In Belidor’s Architecture Hydraulique he describes a different form of horizontal mill. The wheel is a circular rim, and the radii or arms are all oblique vanes or flotes, precisely the fame as the common smoke-jack. This wheel is placed horizontally in a well, to which it is exactly fitten, but the rim of the wheel does not touch the circular wall of the well. The axis of the wheel ascends upwards into the mill-house, and the fpinule of the mill-stone is fixed into it. A horizontal arch-way is conducted to the well fideways, and above the part where the wheel is fitten. This arch conveys the water into the well over the wheel; and beneath the wheel there is a fimilar horizontal arch to carry away the water, after it has paffed through the wheel, that is, in the spaces between its vanes or flotes. The weight of the water fupplies them in a perpendicular direction, and the planes of these flotes being all inclined to the horizon, the action of the fuiure tends to turn the wheel round on its axis, by the fame action as the fmoke upon the vanes of a jack, or like a wind-mill.

The water is supplied in such a body through the upper arch, that the well is always kept full, with a considerable depth of water paffing upon the wheel; whilft the lower arch carries away the water fo freely, that it runs away from beneath the wheel as falt as it can pafs through the vanes of the fame.

The mill defcribed by Belidor was at Toulouse, and contained a number of fuch wheels in a row, each giving motion to one pair of flones.

**Horizontal Machines moved by the Reaction of Water.**—The reaction of water, infuing horizontally through a fpout or orifice, may be employed to communicate motion to machinery; and though this principle has not yet been adopted in practice, it appears from theory, and from fome detached experiments on a small fcale, that a given quantity of water, falling through a given height, will produce greater effects by its reaction than by its impulse. If we fuppoft a vertical pipe of any given height, open at both ends, and that water is poured into it at the top, the water will infue at the bottom of the pipe with a velocity proportioned in a certain manner to its altitude, because every particle of water which infues is prefured upon and impelled by the weight of all the particles which are above it. Now, if we fuppoft the pipe bent or curved at the bottom, fo that it will turn the flream of water into a horizontal position; in this cafe, the fuiure and force, of which we have fpoken, will be deflected from the vertical direction to the horizontal. Now it is clear that the bent part of the pipe, or fome part of the interior surface of the tube oppofite to the orifice, muft fustain all the fuiure which is thus deflected or tranfmitted in another direction; and if the tube is freely prefured, it will retreat before this fuiure, and be put in motion. If we fuppoft the tube to have no reftance to motion, then it would receive all the motion of the water, which would not move at all after it infued from the orifice, but the orifice and tube would move away from the water. This is an impoffible cafe, and in reality the motion of the effluent water will be divided between the pipe or tube and the infuing water, in proportion to the reftance with which each is loaded. Another and perhaps more familiar explanation is, that the water prefures against every part of the interior part of the pipe, except againft the orifice or aperture, which is open; and in confequence, the unbalanced fuiure on the part oppofite to the orifice will tend to put the pipe in motion. A fly-rocket mounts in the air from a similar caufe.

Dr. Barker’s mill by the reaction of water was the fift of this kind of machines, and is defcribed by Defaguilier, in 1743. In his Experimental Philosophy, vol. ii. p. 460, he calls it a machine to prove Mr. Parent’s fpeculation experimentally, viz. that an under-fhot water-mill does moft work, when the water-wheel moves with only a third part of the natural velocity of the water that drives it. He fays, that Dr. Barker had this thought, and communicated it to him, faying, that it would be an experimental proof of Mr. Parent’s fpeculation; in confequence of which, Defaguilier made a working model of it, which he fliowed to the Royal Society, and the experiments upon it, at their meeting in 1742.

It consists of an upright pipe or trunk, communicating with two horizontal branches, like an inverted T; thus, \( \text{L} \). This perpendicular pipe is poifed upon a pivot at the lower end, and the upper end is connected with the fpout of the mill-stone, or other machine to which it is to communicate motion. The top of the pipe is formed into a funnel, into which a flream of water is conducted, and runs down the pipe; the water escapes through a hole in each of the horizontal arms, which holes are near the ends of the arms, and open in open in opposite directions, and in fuch a position that they will direct the flream of water horizontally, and nearly at right angles to the length of the arms.

Suppose water to be poured in at the top of the tube from the fpout, it will then run out by the holes at the ends of the arms, with a velocity corresponding with the depth of these holes beneath the surface of the water in the vertical pipe. The confequence of this must be, that the arms must be prefured backwards, for there is no solid furface at the hole on which the lateral fuiure of the water can be exerted, while it acts with its full force on the fpout of the tube oppofite to the hole. This unbalanced fuiure, acting upon the oppofite fides of both arms, will make the tube and the horizontal arm revolve upon the fpout as an axis.

This will be more easily understood, if we fuppoft the orifices to be shut up, and confider the fuiure upon a cir- cular inch of the arm oppofite to the orifice, the orifice being of the fame fize.

The fuiure upon this circular inch will be equal to a cylinder of water, whose base is one inch in diameter, and whose altitude is the height of the fall; and the fame force is exerted upon the fpout orifice. These two fuiures being equal, and acting in opposite directions, the arm will remain at reft; but as soon as the orifice is opened, the water will infue with a velocity due to the height of the fall. The fuiure of the water upon the orifice will now be removed, and as the fuiure upon the circular inch opposite
from the lower end of the column will acquire the same velocity of motion, from the uniform preffure of the thirty cubic inches which are above it, that one cubic inch let fall from the top would acquire in falling down to the level of the aperture, viz. such a velocity as in a contrary direction would throw or project it to the level from whence it fell, the weights and velocities in both the cases being equal, the products, or what we have called mechanical powers, will also be equal. We might therefore be led to suppose, that a cubic inch of water, let fall through a space of thirty inches, so as to impinge upon a solid body, would be capable of communicating thereto an equal motion or mechanical effect by collision, as if the space cubic inch had descended through the same space with a flower motion, and produced the effect gradually; for in both cases gravity acts upon an equal quantity of matter through an equal space.

It is true that the gravitating force acts a longer space of time upon the body that descends slowly, than upon the other which falls quickly; but this cannot occasion the difference in the effect: for we find by experiment, that an elastic body falling through any given space will, by collision, upon another elastic body which is fixed, rebound nearly to the height from which it fell: or, by communicating its motion to a body equal to itself, will cause that body to ascend to the same height. On these principles we might conclude, as some authors have done, that whatever was the ratio between the power and effect in underfoot wheels, the same would hold true in overfoot, and indeed in all others.

However conclusive this reasoning may seem, it will appear, in the course of the following deductions, that the effect of the gravity of descending bodies is very different from the effect of the stroke, of such as are non-elastic, though generated by an equal mechanical power.

It is true that, in the cases we have above supposed, the power of the fall of water is the same; but the problem proposed to the engineer is, to obtain from it all or as much as possible of the power, and render it applicable to some useful purpose. We have already given our definition of power, that it is weight or matter compounded with motion. Now to obtain all the power from any stream of water, we must abstract from it all its weight and all its motion. In underfoot wheels, or any others moved by the impulfe of the water, we cannot come near this, because we have already shown, that the greatest effect is produced, when the velocity of the wheel is two-fifths of the velocity of the moving water. The water, after it has fulfilled its effect, is discharged with that velocity; hence it retains and carries away with it three-fifths of its original power. Neither can we obtain the full effect of the weight of the water, for another lofs is fullained, in the change of figure which the water experiences, when it strikes the float-board. This is much greater than is usually supposed, in considering machines, although it must be familiar to any one who considers the resistance of a boat, or other body, when drawn through water. No weight is raised in these cases, unless the motion be rapid, (so as to raise a wave before the moving body;) but all the power is expended in changing the figure of the water, by dividing the particles, and putting them in new positions, so that the body can pass between them.

It is to this source that we must look, for the difference between two-fifths of the power, which we find is abstracted from the whole power of the water by an underfoot-wheel, and one-third of the power, which is the utmost we can obtain by means of an underfoot wheel.

In the other classes of machines, which are actuated by the weight of water, we can obtain a much greater share of the power of the descending water. The weight of the water is borne by the machine, which must therefore receive the whole weight of the water, and the lofs is chiefly in the motion which the water still retains after departing from or quitting the machine; but as we are not confined, as in the former instance, to any fixed velocity of motion for the wheel, we may make it move almost as slowly as we please, so that the water will carry away with it a very small share of the velocity which it would have acquired by falling through the height of the fall. Indeed, if we could suppose a wheel to be without friction, and no water to leak or escape from these wheels, or parts of the wheel which contain the water, it would be possible to obtain an effect from it very nearly equal to the power.

Breach-Wheels.—These are very commonly called underfoot wheels, because the water runs beneath the wheel, but improperly, because the water does not shoot against the floats of the wheel, or at least the principal power is derived from the weight of the water. A break-wheel partakes of the nature of both an overfoot and an underfoot, and is constructed as is represented in fig. 1. Plate 1. of Water-mills. The lower part of the wheel is surrounded by a curved wall or sweep of malmory, which is made concentric with the wheel, and the float-boats of the wheel are exactly adapted to the malmory, so as to pass as near as possible thereto without touching it; and the side walls are in like manner adapted to the end of the float-board or sides of the wheel, the intention being, that as little water as possible shall be able to pass by the float-boats without causing the boards to move before it. The water is poured upon the wheel over the top of the breasting at C, the efflux from the mill-dam being regulated by the sluice or shuttle M, which is placed in the direction of a tangent to the wheel, and is provided with a rack N, and pinion P, by which it can be drawn up so as to make any required degree of opening, and admit more or less of water to flow on the wheel.

The water first strikes on the float, and urges it by its impulfe; but when the floats descend into the sweep, they form as it were close buckets, each of which will contain a given quantity of water, and the water cannot escape from these buckets except the wheel moves, at least this is the intention, and the wheel is fitted as close as it can be to the race with that view. Each of the portions of water contained in these spaces bears partly upon the wall of the sweep, and partly upon the floats of the wheel; and its pressure upon the floats, if not exceeded by the resistance, will cause the wheel to move; hence the action upon all the floats which are within the sweep of the breasting is by the weight of the water alone; but the water is made to impinge upon the first float-board with some velocity, because the surface of the water in the dam K is raised considerably above the orifice beneath the shuttle where the water issues.

The upper part of the fall at I is rounded off to a segment of a circle called the crown of the fall, and the water runs over it. The lower edge of the shuttle when put down is made to fit to this curve, so as to make a tight joint; and in consequence when the shuttle is drawn up, the water will run between its lower edge and the crown in a fleet or stream which strikes upon the first float that presents itself, nearly in a direction perpendicular to the plane of the float-board, or of a tangent to the wheel. The float-boats of the wheel are directed to the centre, but there are other boards placed obliquely which extend from one float-board to the rim of the wheel, and nearly fill the space between one float-board and the next. These are called rising-boards, and the use of them is to prevent the water flowing over the float-board into the interior of the wheel; but the edges of these
these boards are not continued so far as to join to the back of the next float, because that would make all the boards of the wheel close, and prevent the free escape of the air when the water entered into the spaces between the floats.

As the water strikes with some force, the rising-board is very necessary, to prevent the water from dashings over the float-boards into the interior of the wheel.

This is the form of break-wheel employed by Mr. Smeaton in the great number of mills which he contrived; but although he speaks of the impulse of the water striking the wheel, he always endeavoured to make the top of the breaking or crown of the fall as high as possible, so as to attain the greatest fall and the least of the impulsive action. All rivers and streams of water are subject to variation in height from floods or dry seasons, and insome this is very considerable; it was therefore necessary to make the crown 1 of the fall at such a height as that in the lowest state of the water R, it would run over the crown in a sheet of three or four inches in thickness, and work the wheel. When the water rose higher in the mill-dam, it would then have a preffure force it through, and in that case would strike the wheel so as to impel it by the velocity.

Mr. Smeaton was well aware that the power communicated by this impulse was very small. In some cases, where the water was very subject to variation, he filled a false or moveable crown, that is, a piece of wood which fitted into the crown I, and raised the surface thereof a foot or more, so as to obtain the greatest fall when the water flood at a mean height; but when the water sunk too low to run over this moveable crown, it could be drawn up to admit the water beneath it. This effect has since been produced in a more perfect manner by making the crown of the fall a moveable shuttle, to rise and fall according to the height of the water in the mill-dam, by which means the inconvenience before-mentioned is avoided.

Improved Break-wheel, in which the Water runs over the Shuttle.—Fig. 7, is a section of one of this kind. A is the water which is made to flow upon the float-board B, and urges the wheel by its weight only, the water being prevented from escaping or flowing off the float-boards by the breach or sweep D D, and the side-walls which inclose the floats of the wheel. The upper part of the breach D D is made by a cast-iron plate, curved to the proper sweep to line with the stone-work. On the back of the cast-iron plate the moving shuttle e is applied; it fits close to the cast-iron so as to prevent the water from leaking between them, and the water runs over its upper edge. F is an iron groove or channel let into the masonry of the side-walls, and in these, the ends of the sliding shuttle are received; f is an iron rack, which is applied at the back of the shuttle, and ascends above the water-line where the pinion g is applied to it to raise or lower the shuttle. The axis of the pinion is supported in a frame of wood I; h H is a toothed sector and balance-weight, which bears the shuttle upwards, or it might otherwise fall down by its own weight, and put the mill in motion when not intended. g is a long plank, which is fixed across between the two side-walls, and retains the water when it rises very high, as in time of floods; but in common times the water rises only a few inches above the lower edge of the plank. When the shuttle is drawn up to touch this lower edge, the water cannot escape; but when the shuttle is lowered down, it opens a space e through which the water flows upon the float-boards of the wheel. This was the form first adopted for the falling-shuttle, but its contraction has since been much improved.

Fig. 4. Plate II. is a section of the most improved form for a break-wheel, taken from the Royal Armoirey Mills, at Enfield Lock, erected by Messrs. Lloyd and Ogle. The general description of this, is like the former, but it is constructed in a better manner, and unites strength with durability. The break of masonry is formed by a cast-iron plate A 2½ feet high, which is set into the masonry of the side walls at each end, and the lower part is formed with a flange, by which it is bolted to the stone-break A A. This plate is made straight at the back for the shuttle to lie against, and it slides up and down. The ends of the grooves are guided by iron groove pieces or channels which are let into the stone-work of the side walls, and being made wedge-like, they fix the ends of the cast-iron break fast in its place. The grooves are not upright, but inclined to the perpendicular so much, that the plane of the gate is at right angles to a radius of the well drawn through the point where the water falls upon the wheel. D is a strong plank of wood, extended between the iron grooves just over the shuttle. When the shuttle is drawn up it comes in contact with the lower side of this piece of wood, and lifts the water; but the piece D is fixed at such a height, that the water will run clear beneath it, unless its surface rises above its mean height.

The float-boards of the wheel do not point to the centre of the wheel, but are so much inclined thereto that they are exactly horizontal at the point where the water first flows upon them. In this way, the gravity of the water has its full effect upon the wheel, and the boards rise up out of the tail-water in a much better position, than if they pointed to the centre of the wheel; and this is more particularly observable when the wheel is flooded by tail-water penned up in the lower part of the race, so that it cannot run freely away from the wheel. The dimensions of this wheel are as follows:—Diameter 18 feet to the points of the floats, and 14 feet wide; the float-boards are 10 inches wide, and each floating-board 11 inches wide. The wheel is formed of four cast-iron circles or wheels, each 14 feet 8 inches diameter, placed at equal distances upon the central axis, which is 14 feet 8 inches long between the bearings or bearings, and 9 inches square; the bearing-necks are 9 inches diameter. The wheel is calculated to make four revolutions per minute, which gives near 3½ feet per second for the velocity with which the float-boards move. The fall of water is 5 feet, and the power of the wheel, when the shuttle is drawn down one foot perpendicularly, equal to 25-horse power.

Break-wheel with two Shuttles.—In this wheel the piece of wood marked D in the last figure, is fitted into the groove of the shuttle, and is provided with racks and pinions to slide up and down, independently of the lower shuttle. The intention of this is, to make the lower shuttle rise and fall, according to the height of the water, so that the water shall always run over the top of it, in the proper quantity to work the mill with its required velocity, whilst the upper shuttle is only used to stop the mill by shutting it down upon the lower shuttle, and preventing the water from running over it. This plan is used when the mill is to be regulated by a governor, or machine to govern its velocity, in that case the governor is made to operate upon the lower shuttle and will raise it up, or lower it down, according as the mill takes too much or too little water, and this regulates the supply; but the upper shuttle is only used to stop the mill, and by this means the adjustment of the lower shuttle is not destroyed, but when set to work again, it will move with its required velocity. Fig. 3. Plate II., Water-wheels, is a section of one of the water-wheels at the cotton-mills of Messrs. Strutt, at Belper, in Derbyshire. The width of this wheel is very great, and to render the shuttles A B firm, a strong
grating of cast-iron, is fixed on the top of the breast K, and
the shuttles are applied at the back of the grating E, so as
to slide up and down against it, the slrain occasioned by the
preference of the water being borne by the grating. The
lower shuttle is moved by means of long ferres, a, which
have bevilled wheels, b, at the upper ends, to turn them,
by a connection of wheel-work with the wheel-work of the
mill. The upper shuttle, A, is drawn up or down by
racks and pinions, c, which are turned by a winch, or handle.
The bars of the grating E are placed one above the other,
like shelves, but are not horizontal; they are inclined, so
that the upper surfaces of all the bars form tangents to an
imaginary circle of one-third the diameter of the wheel
described round the centre thereof. These bars are not
above half an inch thick, and the spaces between them are
2½ inches. The bars are of a considerable breadth, the ob-
ject of them being to lead the water, with a proper slope,
from the top of the lower shuttle A to flow upon the floats
of the wheel. This disposition allows the shuttles to be
placed at such a distance from the wheel as to admit very
strong upright bars of cast iron to be placed between the
wheel and the shuttles, for the shuttles to bear against, and
prevent them from bending towards the wheel, as the great
weight of water would otherwise occasion them to do.
These upright bars are very firmly fixed to the stone-work
of the breast at their lower ends, and the upper ends are
fastened to a large timber, D, which is supported at its
ends in the side walls, and has a truss-framing applied to the
back of it, like the framing of a roof, to prevent it from
bending towards the wheel. The upright bars are placed
at distances of five feet asunder, so as to support the shut-
tles in two places in the middle of their length, as well as
at both ends; and large rollers are applied in the shuttle,
where it bears against these bars, to diminish the friction,
which would otherwise be very great.

These precautions will not appear unnecessary when the size
of the work is known. The wheel is 21½ feet in diameter,
and 15 feet broad; the fall of water is 14 feet, when it is at
a mean height; the upper shuttle is 2½ feet high, and 15 feet
long; the lower shuttle is 5 feet high, and the same length,
so that it contains 75 square feet of surface exposed to the
preference of the water: now taking the centre of the wheel
at two-thirds of the depth, or 3½ feet, we find the preference
equal to that depth of water acting on the whole surface; that is,
the vertical weight of 61 cubic feet of water = 208 lbs. bears
on every square foot of surface, which is equal to 15,600 lbs.,
or nearly 7 tons on the lower shuttle only; but if we take the
two shuttles together, the surface is 112 square feet, and the
mean preference 312 lbs. upon each, or 16 tons in the
whole. The wheel has forty float-boards pointing to the
centre. The wheel is made of cast-iron. There are two
wheels of the dimensions above stated, which are placed in a
line with each other, and are only separated by a wall which
supports the bearings; for they work together as one wheel,
and the separation is only to obviate the difficulty of making
one wheel of such great breadth as 30 feet, though this is
not impossible, for there is a wheel in the farm works 40 feet
in breadth, but it is of wood and not in iron, framed in a
particular manner, as we shall soon describe.

Mr. Buchanans Bucket Water-Wheel for a low Fall.—We
have already shewn, that where water can be made to act
on a wheel by weight, it is much more effectual than when
the same water is made to act by impulse; and we shall shew
this more fully in speaking of overfoot-wheels.

Where the fall is less than half the diameter of the wheel, if the buckets are made in the usual form of the
buckets for overfoot-wheels, the difficulty of filling them
with water, and the short time they are able to retain the
water, are such great defects, that in such cases breath-
wheels, with open float-boards, such as we have described,
have been found in practice to be more advantageous than
bucket-wheels.

Mr. Buchanan suggests, that, by adopting another form
of the buckets, they might be made to act as to be easily filled,
and at the same time capable of retaining the water in a
situation to produce nearly its full effect altogether by
weight, on a low fall.

In a wheel of this construction, contrary to the usual
practice, the water must be poured into the buckets from
within the circle of buckets instead of from without the cir-
cle of buckets. How the filling of the buckets from with-
in can be accomplished may not at first be obvious; but it
can be done without the pentorough, which supplies the
water, making any interference with the arms of the wheel,
if it is constructed as shewn in figs. 4 and 5. Plate 1. Water-
wheel, a. Fig. 4 is an horizontal section of the wheel, and
plan of the pentorough; and fig. 5, an elevation of the
wheel-water.

The buckets in the figure, empty themselves by means of
apertures on the outside of the wheel, which are the whole
length of the buckets, but no wider than just sufficient to
discharge the water from the buckets when they arrive at
the bottom of the wheel, and before they begin to ascend.
A A is the pentorough, into which the supply of water is
conducted. From B to C a part of the wheel is represented,
with the throating removed, to shew the form of the
buckets, and the situation of the water in them; a a, a a,
are the apertures by which the water escapes from the buckets;
b the aperture by which the water enters from the pentorough
to the buckets. The plan, fig. 4, shews, that the arms, N N,
of the wheel, and the circular rims which support the
buckets, occupy only a small part of the breadth of the
circular ring of buckets M; so that about one-third of the
length of the buckets at each end is exposed on the inside
of the circle, and against these parts the penstock is applied,
as shewn at A A, and the arms and rim of the wheel, move
clear of it; but the buckets, as they pass, receive water,
which flows in a continual stream at the orifices, b, b, of the
pentorough; the buckets there become filled from the inside.
The partition-boards or plates which form the buckets are
represented by the white lines in fig. 5, and are so shaped,
that they will retain nearly the whole of the water until they
arrive at the lowest c; the water then begins to escape, and
by the time that each bucket arrives at the lowest point of
the wheel, it will have discharged all the water, and will rife
up empty.

This is a truly ingenious contrivance; but we fear that in
the execution it would present many difficulties, particularly
the ring of buckets M, which could not, we think, be so
firmly affixed, supported by the narrow bearing of the two
arms N, as to preserve their circular figure for
any great length of time; and any bending or warping of
such a heavy mass as a water-wheel will soon destroy it.
Neither is the advantage which could be derived from receiv-
ing the water in close buckets, instead of open float-
boards, so great as is generally imagined.

On the Power and Effect of Breath-wheels.—We shall
fully examine the different effects of the power of water,
when acting by its impulse and by its weight, under the
title of overflow-wheels. In breath-wheels of the common
construction, the effects of impulse and weight are com-
bined; but what is there described being carefully attended
to, the application of the same principles in these combined
cases will be easy.
WATER.

All kinds of machines, where the water cannot descend through a given space, unless the wheel moves therewith, are to be considered as of the same nature with over-fliot-wheels; and equal in power and effect to an over-fliot-wheel, in which the perpendicular height that the water descends from is the same. All those machines that receive the impulse or shock of the water, whether in an horizontal, perpendicular, or oblique direction, are to be considered of the same nature as under-fliot-wheels. Therefore, in a wheel on which the water strikes at a certain point below the surface of the water in the mill-dam, and after that descends in the arc of a circle, pressing by its gravity upon the floats of the wheel, the power will be equal to the effect of an under-fliot-wheel, whose fall is equal to the difference of level, between the surface of the reservoir and the point where it strikes the wheel, added to that of an over-fliot-wheel, whose height is equal to the difference of level between the point where it strikes the wheel and the level of the tail-water.

It is here supposed that the wheel receives the shock of the water at right angles to its radius, and that the velocity of its circumference is properly adapted to receive the utmost advantage of both these powers; otherwise a reduction must be made on that account.

Mr. Otfel, an experienced engineer, informs us, that the velocity of the water-wheel’s circumference should always be between three and four feet per second; but he has not been able to determine which of these two velocities is the best, except in cafes where a wheel is subject to be flooded by tail-water; and in that case four feet per second is best.

Mr. Smeaton advised 33 feet.

On over-fliot Water-Wheels.—An over-fliot-wheel is simply a circular ring of open buckets, so disposed round the circumference of a vertical wheel, as to receive the water from a spout placed over the wheel in such a manner, that the buckets on one side of the wheel shall be always loaded with water, whilst the other side is empty: in consequence, the loaded side will cause it to descend; and by this motion the water runs out of the lower buckets, while the empty buckets of the rising side of the wheel, in their turn come under the spout, and are filled with water.

A machine so simple does not appear to present any difficulties in its execution, which should require any application of theoretic reasoning to remove them; but in reality it is a matter of some delicacy to construct a wheel in such a manner as to obtain the greatest effect from a given fall of water.

It is probable, that the earliest over-fliot water-wheels consisted of a number of wooden boxes or bowls, fastened on the circumference of the wheel; but these would soon give place to a better mode of construction, in which the circumference of the wheel being surrounded by a circular ring at each side, the space between them was divided into separate buckets by partition-boards. These partitions did not point to the centre of the wheel in the direction of radii, but were inclined thereto nearly in an angle of forty-five degrees. By this means, the water which fell from the spout of the trough above, nearly in an horizontal direction, as a tangent to the wheel, would run into the buckets, and fill them as they arrived in succession at the top or highest point of the wheel; but as the buckets changed their position by the descending motion of one side of the wheel, they would become inclined, and the water contained in the buckets would begin to run over the edges of the partitions between the buckets, and by the time the bucket arrived at the bottom point of the wheel, the whole of the water would be run out and leave the bucket empty, and they would remain empty until they ascended on the opposite side of the wheel. By this means, a constant preponderance of one side of the wheel would be kept up by the water falling into the buckets at the bottom of the wheel, and flowing from it at the bottom.

The points chiefly to be considered in constructing an over-fliot-wheel are, first, that the water shall be applied on the circumference of the wheel, so as to be incapable of descending without communicating motion to the wheel, until the water has descended to its lowest position, and that it shall then quit the wheel entirely; secondly, that the utmost height of fall shall be attained and usefully employed; and thirdly, that the weight of resistance to the motion of the wheel shall be so adapted and proportioned to the weight of water which is applied in the descending-buckets of the wheels, that the wheel will move slowly; because we have before shewn, that whatever velocity the wheel moves with, so much velocity the water must retain when it quits the wheel, and will thus carry away some power with it.

We shall now proceed to consider all the particulars which contribute to the attainment of these objects, taking Mr. Smeaton for our guide, and only adding such observations as appear necessary to render his maxims more clear.

1. On the maximum Effect which can be obtained from a Fall of Water by Means of an over-fliot-Wheel.—The effective power of the fall of water must be reckoned upon the whole descent, because it must be raised that height, in order to be in a condition to produce the same effect a second time. The ratio between the powers of the falling water so estimated, and the mechanical effects produced by the wheel at the maximum, deduced from the mean of several of Mr. Smeaton’s experiments, is as 3 to 2 nearly. We have before, in our observations upon the effects of under-fliot-wheels, shewn that the general ratio of the power to the effect, when greatest, was 3 : 1. The effect, therefore, produced by an over-fliot-wheel, under the same circumstances of quantity and fall of water, is at a medium, double that produced by an under-fliot. From this, it appears that non-colic bodies, when acting by their impulse or collision, communicate only a part of their original power; the other part being spent in changing their figure in consequence of the stroke.

The ratio of the power to the effect, computed upon the height of the wheel only, was, at a maximum, as 10 : 8, or as 5 : 4 nearly, because Mr. Smeaton made the wheel of a less height than the fall of water, in order to allow some run or descent of the water through the spout or trough, which conducted it into the buckets of the wheel. We find the ratio, between the power and effect, to continue the same, in cases where the constructions are similar; hence we must infer, that the effects, as well as the powers, are as the quantities of water and perpendicular heights multiplied together respectively.

II. On the most proper Height of the Wheel, in Proportion to the whole Defcent.—The preceding observation shews, that the effect which can be obtained from the same quantity of water, descending through the same perpendicular space, is double when it is made to act by its gravity upon an under-fliot-wheel, to what could be obtained from it when made to act by its impulse upon an under-fliot-wheel.

Hence it follows, that the higher the wheel is, in proportion to the whole descent, the greater will be the effect; because an over-fliot-wheel depends less upon the impulse of the water when it first strikes the wheel, and more upon the gravity of the water in the buckets. The water which is conveyed into the buckets can produce very little effect by its impulse, even if its velocity be great; both on account of
the obliquity with which it strikes the buckets, and in consequence of the loss of water occasioned by a considerable quantity of fluid being dashed over their sides. Instead, therefore, of expecting an increase of effect from the impulse of the water occasioned by its fall through some part of the whole height, we should cause it to act through as much as possible of this height by its gravity, by making the diameter of the wheel as great as possible. But a disadvantage attends even this rule; for if the water is conveyed into the buckets with a very small velocity, which must be the case when the diameter of the wheel equals the height of the fall, the velocity of the wheel will be retarded by the impulsion of the buckets striking against the water, in order to put it in motion, and much power would be lost by the water darting over them. In order, therefore, to avoid all inconveniences, the distance of the spout from the receiving-bucket should, in general, be about two or three inches, that the water may be delivered with a velocity a little greater than that of the wheel; or, in other words, the diameter of an overflow-wheel should be two or three inches less than the greatest height of the fall; and yet it is no uncommon thing to see the diameters of these wheels scarcely one-half of that height. In such a construction, the loss of power is prodigious.

It is always desirable that the water should have somewhat greater velocity, than the circumference of the wheel in coming thereon, otherwise the wheel will not only be retarded by the buckets striking the water, but thereby dashing a part of it over so much of the power is lost.

The velocity that the circumference of the wheel ought to have, will be known by what we shall say next, and the depth of column requisite to give the water its proper velocity, is easily computed from the rules and tables given in this article, and will be found much less than what is generally supposed.

This maxim obliges us to use a wheel, whose diameter is nearly equal to the whole fall; but we shall not gain any thing by employing a larger wheel. It is true, we could then apply the water upon a part of the circumference where the weight will act more perpendicularly to the radius, but we should lose more, by the necessity of discharging the water at a greater height from the bottom, because the water, in all cases, begins to run out of the buckets long before they arrive at the bottom of the wheel.

Suppose the buckets of both wheels equally well constructed in either case, whether the wheel is only as high as the fall, or of a greater height, then the heights above the bottom, where they will discharge the water, will increase in the proportion of the diameter of the wheel. That we shall lose more by this, than we gain by a more direct application of the weight, is plain without any further reasoning, by taking the extreme case, and supposing our wheel enlarged to such a size, that the useful part below would be equal to our whole fall. In this case, the water would be spilled from the buckets as soon as it is delivered into them. All intermediate cases, therefore, partake of the imperfection of this. It was the object of Mr. Buchanan's bucket-wheel, which we have already described, to avoid this difficulty, and employ a height of fall which bore only a small proportion to the whole height of the wheel. This observation necessarily leads us to consider the best form for the buckets.

III. On the best Form for the Buckets of overflow Wheels.—It is impossible to confirmit the buckets so that they will remain completely filled with water till they reach the bottom of the wheel: indeed, if the buckets were formed by partitions directed to the axis of the wheel, the whole water must run out by the time they have descended to the level of the axis; and, in consequence, there must be a great diminution in the mechanical effect of the wheel. Millwrights have, therefore, turned their chief attention to the determination of a form for the buckets which shall enable them to retain the water through a great portion of the circumference of the wheel. An inspection of figs. 2 and 3 will shew at once the proper form which has been established by long practice. These are called elbow-buckets, because each partition is formed by two boards, which are put together with an angle or elbow. The rule for setting these out is, to divide the wheel into the number of buckets it is intended to have; then take five-fifths of the space or interval between two partitions for the depth of the shrouding, that is, the breadth of the circular rings at the sides of the wheel, which form the ends of the buckets, and are called the shrouds; whilst the planking, which forms the bottom of all the buckets, is called the sole of the wheel. That board of each partition which is in the direction of a radius to the wheel, rises from the sole half the depth of the shroud; the other board of the bucket is so inclined, that its outer end shall be advanced beyond the line of the next radius-board, if it was produced.

It is a great advantage to make the partitions of the buckets thin, particularly the edges of the partitions, which will meet and divide the stream of water flowing upon the wheel; and if these edges are not made sharp, they will splash the water about; the edges are, therefore, filed and finished by iron-plate, or it is better to make all the inclined parts of the partition of iron-plate. The greater number of buckets, and the shallower they are, the more regularly the wheel will act. The limits are, that the mouths of the buckets shall be of such width as to allow the air to escape, at the same time that the stream of water flows in; and also that the breadth of the wheel shall not be extravagantly great, to make its buckets contain as much water as would produce the power required from the wheel.

The loss of water, at the lower part of the wheel, will very much depend upon the proportion of water which is poured into each bucket. It is evident, that if the buckets, of whatever form they are made, were totally filled when at the top of the wheel, they must begin to spill the water immediately when they departed from that position. But, on the other hand, if only a part of the content of each bucket is filled with water, then it will bear a greater degree of inclination, and be a longer time before the water will begin to spill from the bucket. This is a reason for making large buckets, and filling only a part of their contents. In practice a medium must be struck between these contending circumstances, and the wheel will act to advantage.

It has been proposed to apply another bend to the partition-boards of each bucket which shall be beyond the inclined board that we have described, and shall be concentric with the rim of the wheel, in the same manner as is represented in Mr. Buchanan's wheel, fig. 5. It is true that this form would retain the water from spilling for a longer time, and thus be an advantage; but it is not favourable for admitting the water into the buckets when at the top of the wheel.

The inclined boards, when made as we have described, may be exactly in the line of the stream of water, which issues from the spout when it passes beneath such stream; and in this way, if the edge of the inclined board is made thin, there will be as little splashing of the water as possible. But by the addition of another part to the edge of the partition, which is concentric to the circle of the wheel, the stream of water cannot be made to proceed exactly in the line
line of the partition, and will therefore splat the water.
The splashing may appear immaterial, but it is in reality very prejudicial, because the broken water fills the mouth of the bucket, and prevents the air from getting out readily, and it is for this reason that it is very necessary to allow so much of the fall above the height of the wheel, as will make the water run into the buckets, with a little greater velocity than the motion of the wheel.

Dr. Robinson, in the Encyclopaedia Britannica, described a plan for the buckets of an overholt-wheel, which was invented by Mr. Robert Burns, millwright, and executed by him at a cotton-mill in Scotland: it is shown in fig. 5, Plate II. Water-wheels. In this way, the wheel has two ranks of buckets, one within the other. The buckets consist of a partition AB, in the direction of a radius of the wheel, which is joined to another BC, inclined to that, and also to a third CD, which is concentric with the rim of the wheel.

The bucket is divided into two, by a partition LM, also concentric with the rim of the wheel, and so placed as to make the inner and outer portions of the bucket nearly of equal capacity. It is evident, without any further reasoning, that this partition will enable the whole bucket to retain its water much longer than the simple one could. When they are filled only one-third, they retain the whole water at eighteen degrees from the bottom of the wheel, and they retain half of the water at eleven degrees. The only objection is, that they do not admit the water quite so freely as buckets of the common construction.

This arises from the air, which must find its way out to admit the water, but is obstructed by the entering water, and occasions a great splattering at the entry. This may be entirely prevented, by making the spout considerably narrower than the wheel, and will leave room at the two ends of the buckets for the escape of air. It was found in practice, that a flow moving wheel, allowed one-half of the water to get into the inner buckets, especially when the partitions which form the inner buckets, did not altogether reach the radius drawn through the midpoint of the outer bucket. The doctor considers this as a very great improvement of the bucket-wheel; and when the wheel is made of a liberal breadth, so that the water may be very shallow in the buckets, it seems to carry the performance as fast as it can go. Mr. Burns made the first trial on a wheel of twenty-four feet diameter, and its performance is manifestly superior to that of the wheel which it replaced, and which was a very good one. It has also another valuable property. When the supply of water is very scanty, a proper adjustment of the stream of water issuing from the spout, will direct almost the whole of the water into the outer buckets; which, by placing it at a greater distance from the axis, makes some addition to its mechanical energy.

IV. Concerning the proper Velocity of the Circumference of an overholt Wheel, in order to produce the greatest Effect.—If a body of water is let fall freely from the surface of the water in the upper reservoir to the bottom of the defcent, it will take a certain time in falling; and in this case, the whole action of gravity will be spent in giving the water a certain velocity. But if this water in falling is intended to act upon some machine, so as to produce a mechanical effect, the falling water must be retarded, because a part of the action of gravity is then spent in producing the effect, and the remainder only will give motion to the falling water, which motion it will retain, after it has quitted the machine. On this principle, the flower a body descends the greater portion of the action of its gravity can be applied to produce mechanical effect, and in consequence the greater that effect will be.

If a quantity of water falls from a stream, into each bucket of an overholt-wheel, it is there retained until the wheel, by moving round, discharges it. Now, the flower the wheel moves, the more water each bucket will receive, because it remains a longer time beneath the spout, so that what is lost in the speed with which the wheel moves, is gained by the preffure of a greater quantity of water acting in the buckets at once; and if considered only in this light, the mechanical power of an overholt-wheel to produce effects will be equal, whether it moves quick or slow. The popular reasoning adduced to prove this has been the following: Suppose that a wheel has thirty buckets, and that four cubic feet of water are delivered in a second on the top of the wheel, and discharged, without any loss by the way, at a certain height from the bottom of the wheel.

It is clear that this stream will supply the same quantity, whatever is the rate of the wheel's motion; and the buckets must be of sufficient capacity to hold all the water which falls into them when the wheel moves very slowly. Suppose this wheel employed to raise a weight of any kind, for instance to draw a basket of coal out of a deep pit or mine, and that the rope winds upon a barrel of such size that the basket will be drawn up with the same velocity as the water in the buckets descends. Suppose, further, that the wheel will make four revolutions in a minute, or one turn in fifteen seconds, when the load or weight in the basket which forms the resistance to the motion of the machine is one-third of the load of water contained in the buckets of the wheel.

Now, during the time of one revolution, sixty cubic feet of water will have flowed into the thirty buckets, and each have received two cubic feet. In this case, the basket may contain a weight equal to twenty cubic feet of water, which weight will be drawn up a height equal to one circumference of the wheel, during one turn of the wheel, or in fifteen seconds of time.

Now suppose the machine so loaded, by making the basket more capacious, that the wheel can only make two turns in a minute, or one turn in thirty seconds, then each descending bucket of the wheel will receive four cubic feet of water. If the basket contained a double weight, viz. equal to forty cubic feet, the effect produced by the machine would be the same as before, because the velocity is only one half; but we find in practice, that it will raise more than in this proportion when it moves slower, for if we attend to what we have just observed of the falling body, we find that so much of the action of gravity as is employed in giving motion and velocity to the wheel and water therein, must be subtracted from its preffure upon the buckets. The produce made by multiplying the number of cubic inches of water which act on the wheel at once by its velocity, will be the same in all cases; yet, as each cubic inch, when the velocity is greater, prefles more lightly upon the buckets than when the velocity is less, the power of the water to produce effects will be greater in the less velocity than in the greater. This leads us to the general rule, that the less the velocity of the wheel, the greater will be the effect produced by any given quantity, and fall of water.

A confirmation of this doctrine, together with the limits it is subject to in practice, is a matter of experiment and observation which has been ably decided by Mr. Smeaton. The velocity of the wheel should not be diminished, further than what will produce some solid advantage in point of power; because, as the motion is slower, the buckets must be made larger, that the increase of their weight may com-
penetrates for the slowness of their motion. The wheel being thus more loaded with water, the speed upon every part of the work will be increased in proportion.

The belt rule for practice will be, to make the velocity of the circumference a little more than three feet in a second.

Experience confirms, that this velocity of three feet in a second, is applicable to the greatest overholt wheels as well as the smallest; and all other parts of the work being properly adapted to this velocity, the fall of a given quantity of water, will produce very nearly the greatest effect possible. But it is also certain from experience, that large wheels may deviate further from this rule before they will lose their power, by a given aliquot part of the whole, than smaller ones can be admitted to do; for instance, a wheel of twenty-four feet high may move at the rate of six feet per second, without losing any considerable part of its power. This may perhaps be accounted for, when we consider how small a proportion of the whole fall is requisite to give the water the proper velocity which the wheel ought to have; whilst in a smaller wheel, the fame height must be allowed for that purpose, and consequently, a greater proportion of the whole height. On the other hand, Mr. Smeaton tells us, that he had seen a wheel of thirty-three feet diameter that moved very steadily and well, with a velocity but little exceeding two feet per second.

There is a natural wish to see a machine move briskly; it has the appearance of activity; but a very slow motion always looks as if the machine was overloaded. For this reason, millwrights have always yielded slowly, and with reluctance, to the advice of Mr. Smeaton, but they have yielded; and we now see them adopting maxims of construction more agreeable to found theory, that is, making their wheels of great breadth, and loading them with a great deal of work. The reluctance to adopt this system did not arise solely from prejudice, but from a real inconvenience attending the slow motion of the wheel when the resistance which is opposed to its motion, and which is the cause that it moves slowly, is not uniform in the different parts of a revolution.

In all machines, there are small inequalities of action which are unavoidable; and in some machines very great inequalities arise, from the interrupting motions of cranks, flappers, and other parts which move unequally or reciprocally. When a water-wheel is employed to give motion to such machines, it may be so refilled or loaded, as to be nearly in equilibrio with its work, in the most favourable position of the parts of the machine; but when these changes into a less favourable position, the machine may drop the wheel altogether, or at all events hobble, and work very irregularly. And for the same reason that a water-wheel accommodates its motion very quickly to the resistance it is to overcome, so all tendency to irregular motion is increased. A wheel, when its load is increased, moves more slowly, and receives more water into each bucket; thereby taking to itself a weight of water equal to overcome its load, and on the other hand, by moving quicker, it takes less water into each bucket when the load is diminished. But these changes do not take place instantaneously, because it can be only in the moment that each bucket passes beneath the stream, that the change of water it shall have, will be influenced by the rate of the wheel's motion. When a bucket is once filled it continues with that charge until it arrives at the bottom of the wheel.

This self-regulating property of the wheel can only apply in cases of small and permanent changes of resistance, for it always comes too late to correct sudden and considerable changes in the resistance; then it acts in the contrary direction. Suppose, for instance, an overholt wheel is employed to work a single pump by means of a crank, the resistance of this machine will be continually varying; it will be nothing during one-half of the period of the revolution when the pump is not drawing any water, and during the other half it will be in a constant state of increase and diminution. Now, during the time this wheel has nothing to do, it will turn round very quickly, and therefore each bucket will receive very little water; consequently, when the wheel comes to be refilled, the wheel will have so little water in its buckets, that it will perhaps be quite stopped: in this case, the bucket beneath stops will receive water until it is quite full, and then the water will run over and fill up of the buckets beneath it, as to put the wheel in motion slowly; in consequence, the succeeding buckets will receive a large share of water during the half revolution when the pump makes its stroke; but when this is finished, and the resistance ceases, the wheel being well loaded with water, will in consequence move very rapidly for a half revolution, and its buckets will receive very little water.

This is indeed an extreme case of irregular resistance, and must be remedied by applying two pumps instead of one, or a balance-wheel, or a fly-wheel; but the same principle will apply in cases of smaller irregularities. In all cases, the resistance must be reduced to a great degree of uniformity, before a water-wheel can be applied to it with advantage, particularly if the wheel is intended to move slowly, with a view of obtaining the greatest power, the irregularities will then have more serious consequences.

A little more velocity enables the machine to overcome those increased resistances by its inertia, or the great quantity of motion inherent in it. Great machines possess this advantage in a superior degree, and will consequently work steadily with a smaller velocity. In all cases, the machine must have so much moving matter in it as is sufficient to overcome the irregularities, and regulate the motion of the wheel. If this is not already found in the machine, as in the mill-stones of a corn-mill for instance, the weight must be placed in the water-wheel itself, or in a fly-wheel applied for the purpose.

Mr. Buchan measured the quantity of water which a cotton-mill required, when going at its common velocity; and when going at half that velocity. The result was, that the last required just half the quantity of water which the first did. In the experiments, the quantities of water were calculated from the depth of water, and apertures of the sluices.

From which experiments, he inferred that the quantity of water necessary to be employed in giving different degrees of velocity to a cotton-mill, must be nearly as the velocity. The water from the cotton-mill on which he made the observation, falls a little below it, into a perpendicular-sided pond, which serves as a dam for a corn-mill. By measuring the time which the water took to rise to a certain height in that pond, he determined the expenditure of water when the corn-mill moved at its common velocity; and also when it moved at nearly half that velocity.

The result of these experiments approached very nearly to the former, and all the differences could be accounted for, by a small degree of leakage, which took place at the sluices on the lower end of the pond; and the time being greater when the mill moved slower, the leakage would of course be greater.
In these experiments, the motion of the water-wheel being exactly proportioned to the quantity of water expended, the load upon the wheel must have been equal when it moved quick or slow, that is to say, the buckets must have been equally filled when the wheel moved at its ordinary motion, or at half that motion.

The effect, therefore, of letting more water on a wheel when the resistance continues the same, is not to lodge a greater quantity in each of the buckets, but to supply the same quantity to each bucket when the wheel is in a greater motion.

The greatest velocity that the circumference of an over-shot wheel can acquire, depends jointly upon the diameter or height of the wheel, and the velocity of falling bodies; for it is plain, that the velocity of the circumference can never be greater, than to describe a semicircular circumference, in the time that a body let fall from the top of the wheel would descend through its diameter, nor indeed quite so great; as a body descending through the same perpendicular space cannot perform its course in so small a time, when passing through a semicircle, as would be done in a perpendicular line. Thus, if a wheel is sixteen feet in diameter, a body will fall through the line of its diameter in one second: this wheel, therefore, can never arrive at a velocity equal to the making one turn in two seconds. An over-shot wheel can never come near this velocity, for when it acquires a certain speed the greatest part of the water is prevented from entering the buckets; and the rest, at a certain point of its descent, is thrown out again by the centrifugal force. The velocity, when this action will begin to take place, depends in a great degree upon the form of the buckets as well as other circumstances; so that the utmost velocity that an over-shot wheel may be capable of is not to be determined generally; and indeed the knowledge of it is not at all necessary in practice, because a wheel, in such case, would be incapable of producing any mechanical effect.

V. On the proper Load for an over-shot Wheel, in order that it may produce a maximum Effect.—The maximum load or resistance for an over-shot wheel, is that which will reduce the circumference of the wheel to its proper velocity, of three or three and a half feet per second; and this will be known, by dividing the effect it ought to produce in a given time, by the space intended to be described by the circumference of the wheel in the same time; the quotient will be the resistance to be overcome at the circumference of the wheel, and is equal to the load required, the friction and resistance of the machinery included.

VI. On the greatest Load that an over-shot Wheel can overcome.—The greatest load an over-shot wheel can overcome depends upon the magnitude of the buckets; and the resistance which will stop the wheel, must be equal to the effort of all the buckets in one semicircumference, when quite filled with water.

The structure of the buckets being given, the quantity of this effort may be afforded, but is of no much importance in practice, as in this case also, the wheel loses its power; for though the water makes the utmost exertion of gravity upon the wheel, yet, being prevented by a counter-balance from moving at all, it is not capable of producing any mechanical effect, according to our definition. An over-shot wheel, generally ceases to be useful before it is loaded to that pitch, for when it meets with such a resistance as to diminish its velocity to a certain degree, its motion becomes irregular; yet this never happens until the velocity of the circumference is reduced to less than two feet per second, where the resistance is equal, as appears not only from the preceding specimen, but from experiments on larger wheels.

VII. Construction of the Pentrough for supplying the Water to over-shot Wheels.—We have hitherto spoken of the stream of water, as if it issued from a spout nearly in an horizontal direction, or within too much inclination as will make the line of the stream correspond with the direction of the oblique part of the bucket-board. This is the ancient, and still the common way; Mr. Smeaton's, which is a much better, is shewn in § 2. Plate I. Water-wheels. G represents the pentrough through which the water flows, and FF strong crofs-beams on which it is supported; the wheel is situated very close beneath the bottom of the trough, as the figure shews. E E are two arms of the wheel, which are put together, as shewn in § 7. D E is the wooden rim of the wheel; the narrow circle beyond is the fection of the pole planking, and on the outside of this the bucket-boards are fixed as the figure shews; one of the bottom boards, B, of the trough at the end is inclined, and an opening is left between that end and the other boards of the bottom, to let the water pass through; this opening is closed by a sliding shuttle, c, which is fitted to the bottom of the trough, and can be moved backwards and forwards by a rod, d, and lever, e, which is fixed into a strong axis; this axis has a long lever on the end, which, being moved by the miller, draws the shuttle along the bottom of the trough, and increases or diminishes the aperture through which the water issues. The extreme edge of the shuttle is cut inclined, to make it correspond with the inclined part b, and by this means it opens a parallel passage for the water to run through, and this causes the water to be delivered in a regular and even sheet; and to contribute to this the edges of the aperture where the water quits it, are rendered sharp by iron plates; the shuttle is made tight where it lies upon the bottom of the trough by leather, so as to avoid any leakage when the shuttle is closed. When the wheel is of considerable breadth, the weight of the water might bend down the middle of the trough until it touched the wheel; to prevent this, a strong beam, O, is placed across the trough, and the trough is suspended from this by iron bolts which pass through grooves in the shuttle, so that they do not interfere with the motion of the shuttle.

Fig. 3. of the same plate is an over-shot wheel, for which Mr. Nouaille took a patent in 1813; he recommends that the water-wheel be made the full height of the fall of water, and that the water be applied upon the wheel at 53 degrees from the vertex. The pentrough is made nearly on the same plan as Mr. Smeaton's. O R is the trough, h g the end inclined in the direction in which the water is intended to be directed, f the shuttle sliding horizontally on the bottom of the trough, c d e the lever for drawing the shuttle, to which motion is given by a regulating screw a and nut b.
wheel can at all times take the utmost fall of the water, even when its height varies from three to four feet. A is the pentrough made of cast-iron; the end of it is formed by a grating of broad flat iron bars, which are inclined in the proper position to direct the water through them into the buckets of the wheel. The spaces between the bars are shut up by a large sheet of leather, which is made fast to the bottom of the iron trough at a, and is applied against the bars; and the pressure of the water keeps it in close contact with the bars, for to prevent any leakage. This is the real shuttle, and to open it for this purpose, the same stream of water to the wheel, the upper edge of the leather is wrapped around a smaller roller; the pivots at the ends of this roller are received in the lower ends of two racks, which are made to slide up and down by the action of two pinsions fixed upon a common axis which extends across the trough; this axis being turned, raises up or lowers down the roller, and the leather shuttle winds upon it as it descends, or unwinds from it, as it ascends, so as to open more of the spaces between the bars, or close them as it is required. In order to make the roller take up the leather, and draw it tight, a strap of leather is wound round the extreme ends of the rollers, beyond the part where the leather shuttle rolls upon it. These straps are carried above water and applied on wheels, which wind them up with a very considerable tension by the action of a band and weight wrapped on the circumference of a wheel, which is on the end of the axis of those wheels.

The water runs over the upper side of the roller, and flows through the spaces between the gratings into the buckets of the wheel; the descent of the water passing through the bars, and afterwards falling into the trough before it strikes the bottom of the bucket, is found fully sufficient to produce the necessary velocity of the water, for a fall of four inches produces a velocity of more than four feet per second.

We recommend this as the best method of applying the water, as we see in all other forms that a much greater portion of the fall is given up in order to make the water flow into the wheel; not that any such depth as is commonly given is at all necessary, but that the aperture in the trough must be placed in such a way that the water will run through it in the very lowest flate of the water, otherwise the wheel will melt at such times.

On the Manner of framing Water-wheels.—The weight of every wheel must be supported by its axis, which therefore demands the first consideration. If the axis is to be of wood it should be made of a tree of hard and durable wood, of a length and size proportioned to the size and weight of the wheel; into each end a gudgeon or centre should be fixed for the wheel to turn upon. There are two methods of fixing the gudgeon into a wooden axis; one is, by forming the gudgeon with a crofs, which is let into the end of the tree, and fastened by screws, and the wood is compounded round the crofs by two or three iron hoops, fitted on the end of the tree and wedged; this is explained in the article Mill-Wark. The other method is, to make a strong iron box in a piece with the gudgeon, into which the end of the tree is received and secured by wedges. The box being of an octagonal shape, and the wood being cut to the same figure, it cannot flip round within the box.

Of late years it has been usual to make the great axis of water-wheels of cast-iron, which is a very good plan, provided the axis is made of sufficient dimensions. This was first practifed by Mr. Smeeon, but he was rather unfortunate, as several of them broke after having been many years in use; he then employed hollow tubes of cast-iron of large dimensions and considerable thickness of metal. Even now that the strength of cast-iron is better understood, it is not uncommon for the axis of a water-wheel to break, particularly in cold and froitory weather, and for this reason some millwrights use wrought iron, but the hollow tube is so much stronger, as to be very secure from accident.

In an iron axis it is advisable to make the bearings of the axis close to the sides of the water-wheel, and leave the ends of the axis projecting beyond the bearings, in order to attach the cog-wheel, by which the power of the wheel is to be communicated to other machinery. This diminishes the length of the axis between the bearings, and renders it much stronger; wooden axes must have the gudgeons at the extreme ends.

The next point to be considered is, the best means of affixing the arms of the wheel firmly to the axis. If the arms are of wood, and the axis also, the most obvious plan is to mortise the arms into the axis; but this is the worst method that can be adopted, because the axis is much weakened, and the water being admitted into the centre of the tree causes it to decay, nor can an arm be safely replaced without taking all the wheel to pieces.

A better way is to use eight timbers for the arms, and put them together so as to intersect each other at right angles, (as is shewn in fig. 1, Plate 1,) leaving a square opening in the centre for the reception of the axis, which is made up to a square by adding pieces of wood to it, and the wheel is fastened on by wedges. The only objection to this, is that the arms are weakened by intersecting each other, and they support the circular rim of the wheel in unequal segments.

In Mr. Buchan's water-wheel, which we have before described in figs. 4 and 5, Plate 1. Water-wheels, is a particular construction of the arms formed by thin planks of wood. He states that this plan is applicable to any kind of water-wheel; and since 1790, when he first contrived a wheel with arms on that principle, a considerable number of large wheels have been erected in Scotland on the same plan. It is evident that arms, such as are commonly fixed in mortises in the axis, are weakest in one direction, and that commonly in the direction of the grain. To remedy this defect the feather-pieces F are applied all round, having their broadest ends towards the centre of the wheel, and being at right angles to the breadth of the principal arms. In order to unite them strongly to the principal arms, and connect the whole more firmly together, a ring of iron, R, is applied on each side; blocks of wood being put in the vacant spaces between, and the keys or wedges, K K, bind the whole close to the axis.

The very best method of uniting the arms to the axis is to have a cast-iron centre-piece, or fling hoop, to fit on the wooden axis with a broad projecting flanch round it, against the flat surface of which the arms of the wheel are applied, and the intervals between them filled up with wooden blocks or wedges; the arms and blocks are firmly bound to the iron flanch by iron rings applied to the arms on the opposite side to the flanch, with screw bolts to go through the whole. This same plan is applicable to an iron axis, and will be more clearly understood by a reference to the article Mill, and Plate XXXIV. Mechanics; but it is there described that the broad circular flanch to screw the arms against, is cast in the same piece with the axis. This was Mr. Smeeon's original plan, but the flanch should be made in a separate piece, and fastened on the axis with wedges; for if cast in the same piece, the contraction of the metal contained in the flanch when cooling, renders the metal of the axis so pliant at the part where it joins to the flanch, and causes them to break at that part. Sometimes the cast-iron centre-piece is made with a
WATER.

The breast-wheel, fig. 3. Plate II. Water-wheels, at Messrs. Strutt's works, which we have already noticed, is deserving of further notice from the manner of putting it together. The rings of the wheel are made of cast-iron, and the float-boards are included between the rings in the manner of an overshot wheel, but the arms are only of wrought iron, being made of small round iron rods, which are very light, and have little strength to resist bending; but as they are all tied in from the centre, the ring cannot deviate from its true circular figure, and to sustain the wheel sideways, oblique bars are extended from the centre-pieces at each end of the axis, and are united to the circular ring in the middle of its breadth, which is 15 feet. We have seen two overshot-wheels of 24 feet diameter, and 9 feet broad, made in the same way. It is plain that in this construction the axis of the wheel can do no office but to support the weight of the wheel; for though these arms are sufficiently strong for that purpose, they have little strength by way of levers to transmit the force of the circular motion of the ring of the wheel to the axis; but the power is transmitted in a better way than from the axis, viz. by a ring of cogs screwed to the circular rim of the wheel, and working in a pinion which conveys the motion to the mill. There is another similar ring of cogs at the other side of the wheel, which works into a pinion fixed on the same shaft, by this means nearly all the strain is taken from the axis of the water-wheels; for the pinion is placed on the descending side of the wheel, so that the weight of the water acting on the float-boards is immediately transmitted to the pinions by the strength of the rings of the wheel.

This method of transmitting the power is also applied to other wheels than those which are made with flight arms like the above; the ring of cogs is sometimes placed in the middle of the breadth of the wheel, and then acts upon one pinion, but it is much better to place it at one side or both sides, if the wheel is very broad, because the circle of the teeth may then be made rather less than the diameter of the rings of the wheel, and the side of the ring being closely fitted to the slone-work of the race, the water may be excluded from the cogs.

It is obvious that of the various constructions of water-wheels, that is the strongest which communicates its motion by means of a ring of cogs immediately attached to its rim, where the power of the water is also applied, the least possible strain being thus thrown on its arms and axis. The only objection to this plan is, that as the teeth of the cog-wheel are in most cases constantly wet, which prevents the grease from adhering, the usual mode of occasionally greasing the cogs is of little or no use, and the dirt in the water grinds away the teeth; or, were the water even free from dirt, there would be much unnecessary friction and waste of power.

Graising Machine for the Cog-Wheel of a Water-Wheel.—Mr. Buchanan mentions two water-wheels of this kind, in which the rings of the teeth were wearing very fast, and knowing the trouble and expense of renewing them, he was solicitous to discover some means of rendering them more durable. The only way which presented itself was by some contrivance to keep them well greased.

This he did by a machine shown in fig. 8. Plate I. Water-wheels; it is nothing more than a kind of pinion, with one or more of its teeth made hollow to contain the greasy substance, and the metal plate of which the hollow cog is composed is perforated with small holes, for exuding the grease through those parts which come in contact with the teeth of the wheel.

Fig. 8. is a section of the greasing machine; A B represents part of the ring of teeth on the circumference of the
water-wheel. The gearing-pinion which works in these teeth is mounted on an axis, as is clearly shown.

N O a retarding lever, of which N is the fulcrum, and O a weight to make it press on the axis of the gearing-pinion, so as to cause a resistance, and make the cogs of the wheel press forcibly on the cogs of the pionon.

G H I K, the hollow teeth for containing the grease; they are made of copper-plate or iron; and to make the perforated sides of the gearing leaves come in close contact with the face of the teeth of the wheel, the lever N O, with a small weight on it, acts on a pulley fixed on the axe of the pionon, and serves to retain it.

E F, &c. the solid teeth of the pionon, made of wood; there are sliders which open for admitting the grease into the hollow teeth at their ends.

The number of leaves in the greater should be such, that those containing the grease shall apply themselves in the course of several revolutions of the wheel to each of its teeth. Mr. Buchanah found a gearing of 12 leaves, 4 of which contained grease; this had effect upon a wheel of 304 teeth; and one of 13 leaves, with one tooth only filled with grease, served a wheel of 168 teeth.

It is best to use a mixture of tallow, oil, and black lead for greasing, made of a consistory to feed regularly, and freshened about twice in a week.

Confrontation of a Breast-Wheel of very great Width.—At Meffrs. Strutt's works is a very powerful breast-wheel, made of the extraordinary thickness of 40 feet, and it deserves our notice from the manner of framing it together; its diameter is only 12 1/2 feet, and it is made without any axis, or rather the axis is hollow, and so large that the float-boards are fixed immediately upon it. It is made like a very long cask, 48 feet long, composed of 32 flaves of six inches thickness, bound together by hoops like an ordinary cask; it is five feet in diameter at one end and six feet at the other, and in the middle 7 feet 2 inches; the small end is made up solid for three feet in length, and the gudgeon is fixed in this solid part; the larger end is solid for four feet from the end, and on this part the large cog-wheel is fixed to communicate the motion to the mill; it is 14 feet diameter, and has 120 cogs, whilst the water-wheel is only 12 1/2 feet diameter to the outside of the floats. The floats are supported by 10 circular rings, which are fixed on the outside of the axis or cask, at four feet distance from each other, and the float-boards are fixed between these rings, 24 floats being arranged in each circle; but the floats in the different spaces are not made to line with each other, because if the water was to strike upon the whole length of 40 feet of float-board at once, it would give a sensible shock to the water-wheel, and work the mill irregularly; hence the floats between all the different rings are placed opposite to the intervals between the floats in the adjoining spaces, by which means the water acts on the floats in rapid succession, so that the stroke upon any one float is imperceptible.

The float-boards are not made to touch the central-barrel or axis within two inches, in order to leave space for the air to escape. The float-boards in the middle of the wheel are 2 feet 4 inches wide, and at the ends are wider. This wheel has two shuttles, one above the other, like the breast-wheel before described in fig. 3, and the same dimensions; for the wheel is placed in the same mill, but is adapted to work when the tail-water rises in time of floods to such a height as to prevent the other wheel from working.

A very large overflow Wheel.—The largest overflow water-wheel of which we have heard, is that at Mr. Crawshaw's iron-works at Cyfarthla, near Merthyr Tydvil, in South Wales: it is used to blow air into three of the large blast furnaces for melting iron; the water-wheel is fifty feet in diameter and fix feet wide: it is chiefly made of cast iron, and has 156 buckets. The axis is a hollow tube, and is strengthened by twenty-four pieces of timber applied round it. On each end of the axis is a cog-wheel of twenty-three feet diameter, which turns a pinion. On the axis of these are two cranks, and a fly-wheel twenty-two feet diameter, and twelve tons weight; each of the cranks gives motion to a lever, like that of a large steam-engine, and works the pinion of a blowing cylinder or air-pump 32 1/2 inches in diameter, and five feet stroke, which blows air into the furnace, both when the pinion goes up and down. The work on the other side being the same, it actuates in the whole four of these double cylinders; the wheel makes about two and a half turns per minute, and each cylinder makes ten strokes. It is called Eolus, and was built in 1800 under the direction of Mr. Watkin George.

At Aberdare, in South Wales, is an immense double water-wheel, consisting of 2 wheels of forty feet in diameter, placed one above the other like the figure 8, (see our article Canal,) the water from the upper one actuating the lower one, and both being connected together by cog-wheels on their respective rings. We understand this machine has not answered, and we only mention it as an attempt to occupy a fall of water of eighty feet; in such cases, the Pressure-engine, described under that article, is a better method, particularly if the work will admit of a reciprocating motion.

Chain of Buckets.—This is applicable in many situations where there is a considerable fall of water. This sketch was taken from one in Scotland used to give motion to a thrashing-mill; the fig. 6. Plate I. is so obvious as to need little explanation. The buckets C, D, G, H, &c. must be connected by several chains to avoid the danger of breaking, and united into an endless chain, which is extended over two wheels A and B, the upper one being the axis which is to communicate motion to the mill-work; E is the spout to supply the water. The principal advantage of this plan is, that no water is lost by running out of the buckets before they arrive at the lowest part, as is the case with the wheel. Another is, that the buckets being suspended over the wheel A of small diameter, it may be made to revolve more gradually than a wheel of large diameter, and without increasing the velocity of the descending buckets beyond what is proper for them. This saves wheel-work when the machine is to be employed, as in a thrashing machine to produce a rapid motion. On the other hand, the friction of the chain in folding over the wheel at the top, and seizing its cogs, will be very considerable; these cogs must enter the spaces in the open links between the buckets, to prevent the chain slipping upon the upper wheel. We think this machine might be much improved by contriving it so that the chain would pass through the centre of gravity of each bucket, whereas in the present form, the weight of each bucket tends to give the chain an extra bend.

The Chain-Pump reversed has been proposed as a substitute for a water-wheel when the fall is very great, and we think it would answer the purpose with some chance of success. It would have an advantage over the chain-pump when employed for raising water, in the facility of applying cup leathers to the pittons on the chain, in the same way as other pumps, which leathers expand themselves to the inside of the barrel, and keep perfectly tight by the pressure of the water. In the chain-pump such leathers cannot be employed, because the edges of the leather-cups would turn down and stop the motion, when the cups were drawn upwards into the barrel. It is the defective mode of leathering the pittons of the chain-pump which occasions its great friction. In the motion of a machine of this kind the
the pitons would descend into the barrel, and might therefore be leathered with cups like other pumps, so as to be quite tight without immoderate friction. This machine was propounded by a Mr. Cooper in 1784, who obtained a patent for it, and Dr. Robison has again propounded it with recommendation.

Mechanism for equalizing the Motion of Water-Wheels.—When a part of the machinery of a mill is suddenly detached from the first mover, or suddenly connected with it, the load of the machine is either increased or diminished; and the moving power remaining the same, an alteration in the velocity of the whole will take place; it will move faster or slower. Every machine has a certain velocity, at which it will work with greater advantage than at any other speed; hence the change of velocity arising from the above cause, is in all cases a disadvantage, and in delicate operations exceedingly hurtful. In the case of a cotton mill, for instance, which is calculated to move the spindles at a certain rate, if from any cause the velocity is much increased, a loss of work immediately takes place, and an increase of waste from the breaking of the threads, &c. on the other hand, there must be an evident loss from the machinery moving too slow. In steam-engines this evil is remedied by a contrivance called a governor, which we have already described in our article Steam-Engine.

Governors are sometimes applied to water-wheels, and made on various constructions. Smith-bellows have been applied to that use, the upper board rising and falling on any augmentation or diminution of the velocity of the lower board, which received its motion from the mill, and forced air into the space beneath the upper board; from this space the air was permitted to escape by a pipe with a cock. If the lower board worked faster than the air could escape, the upper board would rise, but if it moved slower, then the board would sink; and this rising and falling was applied to regulate the throttle of the water-wheel, not by the force of the bellows alone, but the bellows were made to throw the wheel-work of the mill into action, either to raise or lower the throttle.

Of late years a new kind of water-wheel governor has been introduced, the principles of which are nearly the same as the governor of a steam-engine. It has a revolving pendulum, which receives its motion from the mill, and in proportion as the machinery moves faster or slower, the centrifugal force acts with greater or less force upon the balls of the governor, making them approach to, or recede from, the perpendicular axis. This raises or depresses an iron crook, which slides upon the perpendicular axis of the revolving pendulum, and by acting on a lever, is made to engage the fluece with a train of wheel-work, which is kept in constant motion by the power of the water-wheel. When this train is connected with the fluece, it operates upon it fo as to enlarge or lessen the passage of the water to the water-wheel, and by augmenting or lessening the quantity of water falling on the wheel, increases or diminishes its speed.

This fluece is made on the principle of the throttle-valve of steam-engines. In order that it may be moved by a small power, it is poised on an axis of motion passing through the middle of the fluece. When it is turned edgeways to the stream of water, it makes no obstruction; but if it is turned perpendicularly, it cloths the passage of water, or by placing it more or less obliquely, it alters the area of the passage for the water.

The axis on which the fluece turns, if horizontal, should be one-third of the height of the fluece from the bottom, in order that the pressure of the water above the centre may balance that below.

So long as the machinery is moving at a proper velocity, this wheel-work of the fluece apparatus is not connected with the fluece, and it remains at rest. But if the mill goes too slow, the crofs is depressed, and striking the lever in an opposite direction, connects the fluece with a different part or train of wheel-work, which has a motion in a contrary direction to the former, and so produces a contrary effect on the fluece.

The train of wheel-work is so calculated, as to reduce the action on the fluece to a very slow motion, and it is found, from experience, that this is necessary. Where the area of the aperture is too suddenly changed, the effect on the water-wheel would be too violent. See a more complete description of this contrivance in Vol. XXIII. Mill-Work.

On the Construction of the Wheel-race and Water-course.—The wheel-race should always be built in a substantial manner with masonry, and if the stones are set in Roman cement, it will be much better than common mortar. The earth behind the masonry should be very solid, and it is not naturally so, it should be very hard rammed and puddled, to prevent percolation of the water. This applies more particularly to breast-wheels, in which the water of the dam or refervoir is usually immediately behind the wall or breast in which the wheel works, a flaping apron of earth being laid from the wall in the dam to prevent the water leaking. The wall of the breast should have pile planking (see Canal) driven beneath, to prevent the water from getting beneath, because that might blow up the foundation of the race. The stones of the race are hewn to a mould, and laid in their places with great care; but afterwards when the side walls are finished, and the axis of the wheel placed in its bearings, a gauge is attached to it and swept round in the curve, and by this the breast is dressed smooth, and hewn to an exact arch of a circle; the side walls in like manner are hewn flat and true at the place where the float-boards are to work. It is usual to make the space between the side walls two inches narrower at each side, in the circular part where the floats act, than in the other parts.

In some old mills the breast is made of wood planking, but this method has so little durability that it cannot be recommended. In modern mills, the breast is lined with a cast-iron plate, but we do not approve of this, because it is next to impossible to prevent some small leakage of water through the masonry, and this water being confined behind the iron breast cannot escape, but its hydrostatic pressure to force up the iron is enormous; and if the water can ever penetrate itself behind, the whole surface of the plate rarely fails to break it, if not to blow it up altogether. This is best guarded against by making deep ribs projecting from the back of the plate, and bedding them with great care in the masonry; these not only strengthen the plate, but also cut off the communication of the water, so that it cannot act upon larger surfaces at once, than the strength and weight of the plate can resist. Stone is undoubtedly the best material for a breast-wheel. In over-shot-wheels the loss of water, by running out of the buckets as they approach the bottom of the wheel, may be considerably diminished by accurately forming a sweep, or cafling round the lower portion of the wheel, so as to prevent the immediate escape of the water, and causing it to act in the manner of a breast-wheel, which has been already described. While this improvement remains in good condition, and the wheel works truly, it produces a very sensible effect; but it is frequently objected to, because a fliek or a stone falling into the wheel would be liable to tear off part of its shrouding, and damage the buckets; and again, a hard froth frequently binds all fast, and totally prevents the possibility of working during its continuance.
but we do not think the latter a great objection, for the water is not more liable to freeze there than in the buckets or on the shuttle, and may be prevented by the same means, viz. by keeping the wheel always in motion; a very small stream of water left running all night will be sufficient. Mr. Smeaton always used such sweeps, and with very good effect; it is certainly preferable to any intricate work in the form of the buckets.

On setting out Water-courses and Dams.—The most ancient mills were undershot-wheels placed in the current of an open river, the building containing the mill being set upon piles in the river. It would soon be observed that the power of the mill would be greatly increased, if all the water of the river was concentrated to the wheel, by making an obstruction across the river which penned up the water to a requisite height; and also to form a pool or reservoir of water. A sluice or shuttle would then become necessary to regulate the admission of water to the wheel, and other sluices would be necessary to allow the water to escape in times of floods; for though in ordinary times the water would run over the top of the obstruction or dam, yet a very great body of water running over might carry away the whole work, by washing away the earth at the foot of the dam, and then overturning it into the excavation. This is an accident which frequently happens to mills so situated, and the danger is so obvious, that mill water-mills are now removed to the side of the river, and a channel is dug from the river to the mill to supply it with water, and another to return the water from the mill to the river. The difference of level between these two channels is the fall of water to work the mill, and this is kept up by means of a weir or dam entirely across the river; but the water can run freely over this dam in case of floods, without at all affecting the mill, because the entrance to the channel of supply is regulated by sluices and side walls.

The dam should be erected across the river at a broad part, where it will pen up the water as to form a large pond or reservoir, which is called the mill-pond or dam-head. This reservoir is useful to gather the water which comes down the river in the night, and reserve it for the next day's consumption; or for such mills as do not work incessantly, but which require more water, when they do work, than the ordinary stream of the river can supply in the same time. The larger the surface of the pond is, the more efficient it will be; but depth will not compensate for the want of surface, because as the surface sinks, when the water is drawn off, the fall or deficit of the water, and consequently the power of the water, diminishes.

The dam for a large river should be constructed with the utmost solidity; wood framing is very commonly used, but masonry is preferable. Great care must be taken by driving pile planking under the dam, to intercept all leakage of the water beneath the ground under the dam, as that loosen the earth, and destroys the foundation imperceptibly; when a violent flood may overthrow the whole. It is a common practice to place the dam obliquely across the river, with a view of obtaining a greater length of wall for the water to run over, and consequently prevent its rising to so great a height, in order to give vent to the water of a flood. But this is very objectionable, because the current of water constantly running over the dam, always acts upon the shore or bank of the river at one point, and will in time wear it away, if not prevented by expensive works. This difficulty is obviated, by making the dam in two lengths which meet in an angle >, the vertex pointing up the stream. In this way the currents of water, coming from the two opposite parts of the dam, strike together, and spend their force upon each other, without injuring any part. A still better form is a segment of a circle, which has the additional advantage of breadth, because if the abutments at the banks of the river are firm, the whole dam becomes like the arch of a bridge laid down horizontally. This was the form generally used by Mr. Smeaton.

The foot of the dam where the water runs down should be a regular slope, with a curve, so as to lead the water down regularly; and this part should be evenly paved with stone, or planked, to prevent the water from tearing it up, when it moves with a great velocity.

When the fall is considerable, it may be divided into more than one dam; and if the lower dam is made to pen the water up to the foot of the higher dam, then the water running over the higher dam will strike into the water, and lose its force. There is nothing can so soon exhaust the force of rapid currents of water as to fall into other water, because its mechanical force is expended in changing the figure of the water (see circular weir in our article Canal); but when it falls upon stone or wood, its force is not taken away, but only reflected to some other part of the channel, and may be made to act upon such a great extent of surface to do no very striking injury at any one time, but by degrees it wears away the banks, and requires constant repairs: for it is demonstrable that, as much of the force of the water as is not carried away by the rapid motion with which it flows, after passing the dam, must be expended either in changing the figure of the water, or in washing away the banks, or in the friction of the water running over the bottom.

The cotton-works of Meffrs. Strutt at Belper, in Derbyshire, are on a large scale, and the most complete we have ever seen, in their dams and water-works. The mills are turned by the water of the river Derwent, which is very subject to floods. The great weir is a semicircle, built of very substantial masonry, and provided with a pool of water below it, into which the water falls. On one side of the weir are three sluices, each 20 feet wide, which are drawn up in floods, and allow the water to pass sideways into the same pool; and on the opposite side is another such sluice, 32 feet wide. The water is retained in the lower pool by some obstructions which it experiences in running beneath the arches of a bridge; but the principal fall of the water is broken by falling into the water of the pool, beneath the great semicircular weir.

The water which is drawn off from the mill-dam above the weir passes through three sluices, 20 feet wide each, and is then distributed by different channels to the mills, which are situated at the side of the river, and quite secure from all floods. There are six large water-wheels; one of them, which is 40 feet in breadth, we have mentioned, from the ingenuity of its construction; and another which is made in two breadths, of 15 feet each, we have also described. They are all break-wheels. The iron-works of Meffrs. Walker at Rotherham, in Yorkshire, are very good speciments of water-works; as also the Carron works in Scotland.

The largest works for over-shot-mills are in Russia, at Kolpino, near St. Peterburgh, on the river Neva. They were erected principally under the direction of Mr. Gafcgonie of the Carron works in Scotland, and have been greatly improved by the present Director, who is an engineer of his School. An immense dam of granite is built across the river to pen up the water, until it makes a large reservor. The waste and flood waters do not run over this dam, but are conducted out of the reservor by a semicircular branch of the river, and run over a great weir to join the original course of the river below the works. The mills
WATER.

mills are situated in the valley below the great dam, the water being conveyed to the wheels by channels coming through the dam, and conveyed away into a large tail-bason, which is the original course of the river. The wheels, which are very numerous, are all 22 feet diameter. They are placed in several different mills, for rolling and forging iron and copper, boring anchors, &c. These mills are arranged on the sides of the tail-bason, which is navigable to bring the boats up to them. There are also two large saw-mills at the end of the semicircular channel.

These works are very complete, owing to the excellent execution of the dam and water-works; but it is not a good plan to place the mills beneath the dam, because if it should fail, or the water pour over it by an extraordinary flood, the mills and buildings below would be in danger of being carried away; whereas, on the other construction, the mills, being placed at a distance from the river, are perfectly safe, and would not be injured if the dam should be wholly carried away. This is not a fault imputable to the gentlemen we have mentioned, as the foundations of these works were commenced in the time of Peter the Great, and too far advanced to admit of altering the plan radically, when the empress Catherine invited Mr. Galcoigne to Russia, in 1786, to enlarge them to their present magnitude.

On the Distribution of the different Falls of Water in Rivers.

—In erecting a mill, care must be taken to place it so that it shall not be impeded by flood-waters, except when they rise to excess. When the water below will not run off freely, but stands penned up in the wheel-race, so that the wheel must work or row in it, the wheel is laid to be tailed, or to be in back water or tail water.

Upon most rivers in this country all the falls of water are fully occupied, and at every mill there is a weir, which pens up the water as high as the mill above can suffer it to stand without inconvenience. Each miller is anxious to obtain the greatest possible fall, and he can at any time augment the fall, by raising the surface of his weir; but as this may produce an inconvenience to the mill above, in preventing the water from running freely away from its wheel, it is a constant source of dispute and litigation. A mill may be subjected to tail-water by the concurrence of so many circumstances, that it is frequently very difficult to know where to seek the best remedy, whether the miller ought to raise his wheel higher and diminish his own fall, or to infilt upon a diminution of his neighbour’s below him by lowering his weir.

The following rule is that which Mr. Smeaton constantly followed, in placing successive dams upon rivers, whether for the erection of mills or for navigation. In flat countries, where the falls of water are small, and consequently tail or back water is most troublesome, those dams must be so built that no water shall pass the wheel into the wheel-race of the mill next above it, when the river is in its ordinary summer’s state. The same rule we have found generally subsisting in ancient mills.

This rule is founded upon reason; for if the erection of a dam does not affect the mill above by tail-water, in dry seasons, when water is the most scarce, it can do no material injury at any other time. Every mill that is well and properly constructed will clear itself of a considerable depth of tail-water, provided it has at the time an increase of the height of water in the mill-dam or head, and an unlimited quantity of water to draw upon the wheel; for if floods produce tail-water, they also increase the head water, and afford a super-ior quantity to be expended. This is the proper means by which a number of mills on the same river are to be cleared of back-water, as far as is consistent with the mutual enjoy-
WATER.

which will be exerted upon each stone of the masonry to thrust it outwards.

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<thead>
<tr>
<th>Depth beneath the Surface in Feet.</th>
<th>Pressure on each stone or on every square Foot, in Pounds.</th>
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<tbody>
<tr>
<td>1</td>
<td>62.5</td>
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<tr>
<td>2</td>
<td>125</td>
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<tr>
<td>3</td>
<td>187.5</td>
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<td>9</td>
<td>562.5</td>
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<tr>
<td>10</td>
<td>625</td>
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</table>

The length and width of the tank does not influence the pressure upon each stone; because, following our first proposition, we are only to regard the magnitude of the plane against which the water acts, and the depth at which it is situated beneath the surface. But in all cases when the plain is not horizontal, the depth of the water will be greater upon some parts of the plane than upon others. The depths must therefore be taken from the centre of pressure of the plane; see that article in Vol. VII.

The knowledge of the centre of pressure is required, in order to apply this calculation to wooden vessels, such as the large backs used by brewers; or to find the pressure against the gates of a sluice or lock, or in any other case where the wood planks, or the stones of the masonry are so united together into one mass, that the whole side of the vessel must be removed together. If the plane against which the water acts rises up as high as the surface of the water, and is of a rectangular figure; that is, if all its horizontal dimensions, whether taken at the bottom of the vessel or at the top, are equal, then the centre of pressure is situated at 3/6 of the greatest depth beneath the surface.

Example.—A wooden vat is 18 feet long, and contains water 6 feet deep; required the force which the water exerts against the side of the vat to force it outwards. Two-thirds of 6 feet is 4 feet, which is the depth of the centre of pressure: \( 4 \times 62.5 = 250 \) lbs. is the mean pressure upon each square foot of the plane, 18 feet long \( \times 6 \) feet deep = 108 square feet of area \( \times 250 \) lbs. 27,000 lbs., which is the force exerted against the side of the vessel, and must be resisted by the strength of the materials.

On the Means of measuring or gauging the Quantity of running Water.—The ancients seem to have had no other measure of running water than that uncertain and fallacious one, which depended wholly on the perpendicular section of a stream, without considering the velocity of the motion. The first who opened a way to the truth was Benedikt Castelli, an Italian, and friend of Galileo. He first shewed that the quantity of water, flowing through a given section of a stream, is proportional to the celerity with which the water is carried through that section. This observation engaged philosophers to study the doctrine of the motion of fluids with much diligence, and after Castelli's time there was scarcely any mathematicians who did not endeavour to add something thereto, either by experiments or by reasoning and argument.

But few of them, until the illustrious Sir Isaac Newton, had any successes, because of the exceeding difficulty of the subject.

Those who studied the theory laid down such theorems as were found to be false, when brought to the test of experiments, and those who laboured in making experiments frequently omitted to observe some minute circumstances, the importance of which they had not yet perceived. Hence they differed greatly from one another, and almost all of them erred from the real measure.

The theory of hydraulics has never been carried to a very high degree of perfection upon mathematical foundation alone, nor has it hitherto, even with the assistance of experiment, been rendered of much practical utility. Newton began the investigation of the motions of fluids on true principles. Daniel Bernouilli added much valuable matter to Newton's propositions, both from calculation and experiment. D'Alembert, and many later authors, have exercised their analytical talents in inquiries of a similar nature.

Dr. Robison observes that these, and other mathematicians of the first order, seem to have contented themselves with such views as allowed them to entertain themselves with elegant applications of calculus. They rarely had any opportunity of doing more, for want of a knowledge of facts, but they have made excellent use of the few which have been given them.

It requires much labour, great variety of opportunities, and great expense, to learn the multiplicity of things which are combined, even in the simplest cases of water in motion. These advantages seldom fall to the lot of a mathematician, and he is without blame when he enjoys the pleasures within his reach, and cultivates the science of geometry in its most abstract form. Here he makes a progress which is the boast of human reason, being almost inferred from every error, by the intellectual simplicity of his subject. But were we to turn our attention to material objects, we know neither the size and shape of the elementary particles of water, nor the laws which nature has prescribed for their action. We cannot, therefore, presume to foretell their effects, calculate their exertions, or direct their actions, with any reasonable expectations of certainty.

A different and more practical mode of attaining hydraulic knowledge, has been attempted by a distinct class of investigators. These have begun from experiment alone, and have laboriously deduced, from very ample observations of the actual results of various particular cases, the general laws by which the phenomena appear to be regulated, or at least the formulas by which the effect of new combinations may be predicted. But it must be confessed, that these formulas, however accurate, are almost too intricate to be retained in the memory, or to be very easily applied to calculations from particular data.

There are two gentlemen whose labours in this respect deserve very particular notice, professor Micheletti, at Turin, and abbé Boffut, at Paris. The first made a prodigious number of experiments, both on the motion of water through pipes and in open canals. The experiments of Boffut are also of both kinds, and though on a much smaller scale than those of Micheletti, they seem to deserve equal confidence. The chevalier de Buat, who has taken up this matter where the abbé Boffut left it, has prosecuted his experiments with great affinity and singular success.

Mr. Eytelwein, a gentleman honoured with several employments and titles relative to the public architecture of the Prussian dominions, made a translation of Buat's works into German, with important additions of his own; and he also published "Handbuch der Mechanik und der Hydraulik," Berlin, 1801. In this compendium of mechanics and hydraulics, he has collected the principal facts that have been ascertained, as well by his own experiments as by those of former authors, especially such as are the most capable of practical application. He appears to have done this in so judicious a manner, as to make his book a most valuable abstract.
abstract of every thing that can be deduced from theory, respecting natural and artificial hydraulics. The elegant conciseness of his manner deserves so much the more praise, as his countrymen too often make a merit of prolixity.

In our article Discharge, we have given the general principles of the motion of spouting fluids; and under River the theory of water running in rivers. The object of the present article will be to lay down such rules as may be immediately applicable to the use of the engineer.

In all cases of gauging streams, the quantity which flows, in any given time, is obtained by measuring the area of the aperture, or channel, through which the water flows, and finding the velocity with which the water moves through that aperture. To find the area of the aperture is a simple operation of mensuration, but to ascertain the velocity is not so easy. There are two different methods of determining the velocity. The first is, by observing the rate of motion of the surface, either by means of small light bodies thrown into the stream, or by employing instruments adapted to measure the rate at which the stream moves. This method is only applicable in cases of open canals and rivers, where the water flows with a flow motion. The other method is more general, and is applicable to the greatest velocities; because it is derived from calculation, according to the depth of water, or height of column, which urges the flowing water, and occasions its motion.

To measure the Quantity of Water running in a River or Canal. First Method.—Choose a part of the channel where the banks are of a determinate figure, and where they continue of the same breadth and depth for a length of ten, twenty, or thirty feet, the longer the better, and the more regular the banks are, the better the observations will be. Measure the breadth and the depth, or other dimensions which may be necessary, to find the area, or section of the passage, through which the water flows. Take these measures at several different points, and if there is any difference at different places, find the area at each place, and take a mean between them.

Then proceed to find the velocity of the motion, by throwing in a cork, or other light body, and observing, by a float-watch, or pendulum, what number of seconds it takes to flow through a given length of the channel; for instance, the length of ten, twenty, or fifty feet, which was chosen in the first instance for the experiment, and marked out by stretching two strings, parallel across the river. This trial must be repeated several times, and, as the instant when the floating body arrives at the last string, can be very exactly noted, this method admits of considerable exactness. A mean of the different results must be taken for the true velocity.

It is true that this only gives the velocity of the water at the surface, and the water moves with different velocities at different depths, beneath the surface; (instead of a single light body to float upon the surface of the water), we are recommended to employ a cylindrical rod of wood, of a length something less than the depth of the water: this is to be ballasted by a weight at the lower end, so that it will swim just upright in standing water, and with the upper end of the stick about an inch above water. By using this, instead of a single cork, we are supposed to attain the mean velocity of the stream at its different depths, instead of the velocity of the surface.

Instead of a cylinder of wood, three or four apples, slung together by a string, will answer the purpose very well, the lower ones being loaded by putting nails in them till they are rather heavier than water, so that the apples, when put into standing water, will hang in a per-
the stream per second in feet will be 6.5 times the square root of the height.

If the height be measured in inches, then the velocity in feet per second will be 1.88 times the square root of the height, nearly. It will be easy to put the funnel into the most rapid part of the stream, by moving it about to different places, until the difference of altitude in the two tubes becomes the greatest. In some cases, it will happen that the immersion of the instrument will produce a little eddy in the water, and thus disturb the accuracy of the observation; but keeping the instrument immersed only a few seconds will correct this. The wind also would affect the accuracy of the experiments; it is therefore advisable to make them when there is little or no wind.

By means of this instrument, the velocity of water at various depths in a canal or river may be found with tolerable accuracy, and a mean of the whole drawn. Where great accuracy is not required, the bent tube with the funnel at bottom will alone be sufficient, because the surface of the water will be indicated with tolerable precision by that part of the prismatic frame for the tube which has been moistened by the immersion.

M. Pitot likewise proposed that a similar instrument should be used instead of a log, to determine the rate at which a ship fails. For this purpose, in the middle of a vessel, or as near as can be to the centre of its oscillations, place two tubes of metal of three or four lines in diameter, one of them being straight, and the other bent at bottom and enlarged into a conical funnel. The lower ends of both are to dip into the water in which the vessel fails, and there will be no evil to apprehend from orifices so minute. Into these metallic tubes, two others are closely fitted at a convenient height for the observations. The water will rise, in the frill of these tubes, up to its level on the outside of the ship; and in the second, up to a certain height, which will indicate as above the velocity of the vessel. For the funnel being turned towards the prow of the ship, it will, in consequence of the motion, be affected in like manner, as if it were plunged into the stream of a running water. The actual velocity of the vessel is found by the same rules as that of the current. This method has been repropaged in this country, without any acknowledgments to M. Pitot. We do not, however, recommend its adoption on board a ship; for, notwithstanding its theoretical ingenuity, it is liable to many sources of error in practice, and would not, it is probable, furnish more accurate measures of a ship's way, than those deduced from the common log.

In the practical use of M. Pitot's instrument, a great difficulty is experienced from the oscillations of the water in the tubes, which it is not easy to prevent, and a mean height of the oscillating water must be taken.

M. Du Buat made trials of the instrument, and found it could not be trusted for any other purposes than to give the ratios of different velocities. He found the instrument was better without the straight tube, and he employed only one tube with its lower end turned horizontally, in the direction of the stream, it was made of tinned plate instead of glass, and sufficiently large to admit a float to show the height of the water in the tube. Instead of making the end of the tube an open trumpet-mouth, he used to close it by a flat plate, with a small perforation in the centre to admit the water through it, or in some cases several small perforations. In this way, the water will rise in the tube, just the same as if it was open; but the oscillations of the column will be avoided, or greatly diminished.

The hydraulic quadrant has been recommended by several authors, for measuring the velocity of water.

It consists of a small quadrant with a divided arch, and having two threads moving round its centre. One of these is short, and carries a plummet which always hangs in air, and serves to place the quadrant in its true position. The other thread is longer, and carries a weight whose specific gravity is greater than that of water, and which plunges more or less deep in the current as the thread is lengthened. The instrument is held over the water, so that the plummet of the long thread hangs in the water, and the force of the current will remove it from the perpendicular, whilst the angular distance from the other thread, which is a vertical line can be ascertained by the divisions on the arch of the quadrant; the quantity of this deviation from the perpendicular is the measure of the force, and consequently of the velocity of the current. Boffut has shown, that the force of the current is as the tangent of the angle which one thread makes with the other, and gives directions for using this instrument to try a current at different depths.

Dr. Brewster, in his edition of Ferguson's lectures, recommends a small and light wheel, like an underfoot water-wheel, with float-boards on its circumference. It is provided with an apparatus to ascertain and record the number of turns it makes, and is held in the stream, so that the water may act upon the float-boards to turn it round; and from the number of turns it makes in any given time, the velocity of the stream may be computed. He directs the wheel to be made of the lightest materials, and about ten or twelve inches in diameter: it is furnished with fourteen or sixteen float-boards. The centre of the wheel is perforated with a hole, and tapped to receive a delicate fork or wire, which forms the axis upon which it revolves, with as little friction as possible. At each end of the ferow or axis, is a handle to hold it by, and to support the wheel; and to one of these handles an index is fixed, pointing to divisions on the circumference of the wheel, which consist of 100 parts. This index shows the aliquot parts of a revolution, whilft the number of threads which the wheel advances on the screw shows the number of whole turns it makes.

To prepare this instrument for use, the wheel must be turned round upon the screw until it arrives quite at one end of it, and till the index points to zero of the divisions on the rim of the wheel; then hold the axis or screw horizontally by the two handles, so that the float dips in the water and turn the wheel round upon the screw.

By means of a flop-watch, or a pendulum, find how many revolutions of the wheel are performed in a given time, a minute, for instance. Multiply the mean circumference of the wheel, i.e. the circumference deduced from the mean radius, measured from the centre of impulsion upon the float-boards to the centre of the wheel, by the number of revolutions, and the product will be the number of feet which the water moves through in the given time. On account of the friction of the ferow, the resistance of the air, and the weight of the wheel, its circumference, will move with a velocity a little less than that of the stream; but the diminution arising from these causes, may be estimated with sufficient precision for all the purposes of the practical mechanic.

This, we think, is one of the best stream-measurers, because it will give a correct measure of the motion at the surface of the water; but it will not give the velocities at the different depths beneath the surface, nor do we know any machine which will effectually answer that purpose.

By means of this instrument, we can obtain the velocity of the surface with greater accuracy than perhaps by any other means; but to ascertain the quantity of water which shall
WATER.

Dr. Robison gives the following table of these three velocities, which will save the trouble of calculation in some of the most frequent questions of hydraulics.

<table>
<thead>
<tr>
<th>Velocity in Inches per Second</th>
<th>Velocity in Inches per Second</th>
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</thead>
<tbody>
<tr>
<td>Surface</td>
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<td>0.537</td>
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The knowledge of the velocity at the bottom is of use to an engineer, to enable him to judge of the action of a stream on its bed. Every kind of soil will bear a certain velocity without changing the form of the channel. A greater velocity would enable the water to tear it up, and a smaller velocity would permit the deposition of more movable materials.
WATER.

It is not enough, then, for the permanency of a river, that the accelerating forces are so adjusted to the size and figure of its channel, that the current may acquire an uniform velocity, and cease to accelerate. It must also be in equilibrio with the tenacity of the channel.

It appears from observation, that a velocity of three inches per second at the bottom, will just begin to work upon fine clay fit for pottery, and however firm and compact it may be, it will tear it up. Yet no beds are more stable than clay, when the velocities do not exceed this, for the water soon takes away the impalpable particles of the superficial clay, leaving the particles of sand sticking by their lower half in the rest of the clay, which they now protect, making a very permanent bottom; if the stream does not bring down gravel or coarse sand, which will rub off this very thin crust, and allow another layer to be worn off. A velocity of six inches per second, will lift fine sand; eight inches will lift sand as coarse as linseed; twelve inches will sweep along fine gravel; twenty-four inches will roll along rounded pebbles an inch in diameter; and it requires three feet per second at the bottom to sweep along shattered angular flakes of the size of an egg.

Dr. Young gives an excellent simple rule for the same object, which is only a trifle different from Dr. Robison's; he states, that from a mean of all the best experiments, he found that, if the square root of the mean velocity of any stream (running in an uniform open channel) be added to such mean velocity, it will give the superficial or top velocity in the middle; or if deducted therefrom, it will leave the bottom velocity: whence we have deduced the following practical rule, viz.

1. Having found the top velocity, expressed in any convenient measure, which will correspond with the result required.

To find the bottom velocity, add the constant number .25 (or \(\frac{1}{4}\)) to the top velocity; extract the square root of the sum, and double it; again add 1 to the top velocity, and from the sum deduct the double root before found: the remainder is the bottom velocity of the stream.

2. To find the mean velocity from the top velocity, add the constant number .5 (or \(\frac{1}{2}\)) to the top velocity, and from their sum deduct the square root found in the first rule: the remainder is the mean velocity.

Or, 3. To find the mean velocity from the bottom velocity, add the constant number .25 (or \(\frac{1}{4}\)) to the bottom velocity, and extract the square root of the sum; then to this square root add the bottom velocity, and the constant number .5, and their sum is the mean velocity.

These are true in all cases, provided the top and bottom velocities are related to each other, as Dr. Young states. For example, Mr. Watt observed the surface of the water in an open canal to move with a velocity of 17 inches per second: What was the bottom velocity?

By our first rule \(17 + .25 = 17.25\), of which extract the square root; it is 4.15; twice this is 8.3. Again, to the top velocity 17 add 1, and deduct 8.3, it leaves 9.7 for the bottom velocity. Mr. Watt observed the bottom velocity to be 10 inches per second.

2. To find the mean velocity, add .5 to the top velocity 17, it gives 17.5; deduct 4.18, and we get 13.32 inches per second for the mean velocity.

3. If we take Mr. Watt's observation of the bottom velocity of 10 inches per second, instead of the top; then to find the mean velocity \(10 + .25 = 10.25\), of which the square root is 3.201; and 10 + .5 = 10.5; add these together, thus \(3.201 + 10.5) = 13.701\) inches per second for the mean velocity; which only exceeds that deduced from the top velocity by little more than \(\frac{1}{4}\) of an inch in a second.

By the aid of this rule, and the wheel stream-measurer before described, great accuracy may be obtained. Care must be taken to apply the wheel in the centre of the stream, on the surface, or rather at that place where the velocity of the surface is found to be the greatest.

Second Method of measuring the Flowing of Water in an open Canal.—When a river flows with an uniform motion, and is neither accelerated nor retarded by the action of gravitation, it is obvious that the whole weight of the water must be employed in overcoming the friction of the water against the bottom and sides.

The principal part of this friction is as the square of the velocity, and the friction is nearly the same at all depths: for professor Robison found, that the flow of the fluid through a bent tube was not increased by increasing the pressure against the sides, being nearly the same when the bended part of the tube was situated horizontally, as when vertically, the same difference of level being preferred.

The quantity of friction will, however, vary, according to the surface of the fluid which is in contact with the solid, in proportion to the whole quantity of fluid; that is, the friction for any given quantity of water will be, as the surface of the bottom and sides of a river directly, and as the whole quantity of water in the river inversely; thus, supposing the whole quantity of water to be spread on a horizontal surface equal to the bottom and sides of the river, the friction is inversely as the depth at which the river would then stand. This is called the hydraulic mean depth.

If the inclination or slope of the surface of water in a river varies, the descending weight, or the force that urges the particles down the inclined plane, will vary as the height of the fall in a given distance; consequently, the friction, which is equal to the descending weight, must vary as the fall; and the velocity being as the square root of the friction, must also be as the square root of the fall. Supposing the hydraulic mean depth to be increased or diminished, the inclination remaining the same, the friction would be diminished or increased in the same ratio; and, therefore, in order to preserve its equality with the descending weight, the friction must be increased or diminished, by increasing the velocity in the ratio of its square to the hydraulic mean depth; that is, increasing the velocity in the ratio of the square root of the hydraulic mean depth.

Mr. Eytelwein's Rule is, that the velocity of a stream will be in the joint proportion of the square root of the hydraulic mean depth, and the square root of the fall in a given distance; or as a mean proportional between these two quantities.

Taking two English miles for a given length upon a stream, we must find a mean proportional between its hydraulic mean depth and its fall in two miles in inches, and inquire what relation this bears to the velocity in a particular case. We may hence expect to determine it in any other. According to Mr. Eytelwein's formula, this mean proportional is \(\frac{1}{4}\) of the velocity in a second in inches.

In order to examine the accuracy of this rule, we may take an example, which could not have been known to Mr. Eytelwein. Mr. Watt observed, that in a canal 18 feet wide above, and 7 below, and 4 feet deep, having a fall of 4 inches in a mile, the velocity was 17 inches per second at the surface, 14 in the middle, and 10 at the bottom. The mean velocity may be called 13.2 inches, in a second. Now to find the hydraulic mean depth, we must divide the area of the
the section \( \frac{18 + 7}{2} \times 4 \) = 50 square feet, by the breadth of the bottom and length of the floping sides added together; whence we have 50, or 29.13 inches: and the fall in two miles being 8 inches, we have \( \sqrt{(8 \times 29.13) = 15.25} \) for the mean proportional; \( \frac{1}{4} \) ths of which is 3.90, agreeing nearly with Mr. Watt's observation. Professor Robison has deduced from Baut's elaborate theorems 12.558 inches for the velocity, which is considerablly less accurate.

For another example we may take the river Po, which falls one foot in two miles, where its mean depth is 29 feet, and its velocity is observed to be about 55 inches in a second. Our rule gives 58, which is perhaps as near as the degree of accuracy of the data will allow.

On the whole, we have ample reason to be satisfied with the expected coincidence of so simple a theorem with observation; and in order to find the velocity of a river from its fall, or the fall from its velocity, we have only to reckon that the velocity in inches per second is \( \frac{1}{4} \) ths of a mean proportional between the hydraulic mean depth and the fall in two English miles in inches. This is, however, only true of a straight river flowing through an equable channel.

For the slope of the banks of a river or canal, Mr. Eytelwein recommends, that the breadth at the bottom should be \( \frac{3}{4} \) ds of the depth, and at the surface \( \frac{1}{4} \) ds; the banks will then be in general capable of retaining their form. The area of such a section, is twice the square of the depth, and the hydraulic mean depth is \( \frac{3}{4} \) ds of the actual depth.

M. Du Baut’s Rule.—In our article RIVER, we have given the theorem of M. Du Baut for calculating the motion of water in a river or other regular channel, or through pipes. It has been observed by the late Dr. Robison, that the comparison of the chevalier Du Baut’s calculations with his experiments is very satisfactory; that it exhibits a beautiful specimen of the means of expressing the general result of an extensive series of observations in an analytical formula, and that it does honour to the penetration, skill, and address of M. Du Baut, and of M. De St. Honore, who assisted him in the construction of his expressions.

Dr. Young’s Rule.—Dr. Young justly remarks, in an excellent paper in the Philosophical Transactins for 1808, that the form of Du Baut’s expressions is not so convenient for practice as they might have been rendered; and are liable to great objections, in particular cases: for when the pipe is extremely narrow, or extremely long, they become completely erroneous. Dr. Young has, therefore, substituted for the formula of M. Du Baut others of a totally different nature; and he professes to have followed Du Baut only, in his general mode of considering a part of the pressure, or of the height of a given fall, as employed in overcoming the friction of the pipe, through which the water flows out of it; a principle which, if not of his original invention, was certainly first published by him, and reduced into a practicable form. We find Mr. Smeeaton used it in constructing his MS. tables. By comparing the experiments which Du Baut has collected, with some of Gerfler’s, and some of his own, Dr. Young discovered a formula, which appears to agree fully as well as Du Baut’s, with the experiments from which his rules were deduced, and at the same time accords better with Gerfler’s experiments; and which formula extends to all the extreme cases with equal accuracy. It seems to represent more simply the actual operation of the forces concerned; and it is direct in its application to practice, without the necessity of any successive approximations.

He began by examining the velocity of the water discharged through pipes of a given diameter, with different degrees of pressure; and found that the friction could not be represented by any single power of the velocity, although it frequently approached to the proportion of that power of the velocity, of which the exponent is 1.8; but that it appeared to consist of two parts, the one varying simply as the velocity, the other as its square. The proportion of these parts to each other must, however, be considered as different, in pipes of different diameters; the first part being less perceptible in very large pipes, or in rivers, but becoming greater than the second in very minute tubes; while the second also becomes greater, for each given portion of the internal surface of the pipe, as the diameter is diminished.

If, with Dr. Young, we express all the measures in English inches, calling the height employed in overcoming the friction \( f \), the velocity in a second \( v \), the diameter of the pipe \( d \), and its length \( l \); we may make \( f = a \frac{l}{d} v^2 + 2 c \frac{l}{d} v \); for it is obvious, that the friction must be directly as the length of the pipe; and since the pressure is proportional to the area of the section, and the surface producing the friction to its circumference or diameter, the relative magnitude of the friction must also be inversely as the diameter, or nearly so, as Du Baut has justly observed.

We shall then find, that \( a \) must be \(.000001 \times 413 + 75 \)

\( \frac{1440}{d + 12.8} - \frac{180}{d + 355} \), and \( c \) must be \(.000001 \times 900 dd + \frac{1}{r} \left( \frac{1085 + 13.2}{d^2} + 1.2563 \right) \).

Hence it is not difficult to calculate the velocity for any given pipe, open canal or river, with any given column of water: for the height required for producing the velocity, including friction, is, according to Du Baut, \( \frac{v}{510} \); or rather, as it appears from almost all the experiments which the doctor compared, \( \frac{v}{586} \); and the whole height \( b \) is, therefore, equal to \( f + \frac{v^2}{586} \), or \( b = \left( \frac{a l}{d} + \frac{1}{586} \right) v^2 + 2 c \frac{l}{d} v \); and assuming \( b = \frac{1}{a l + d + .0017} \), and also assuming \( c = \frac{b c}{d} \), we have \( v^2 + 2 c v = b b \); whence,

\( v = \sqrt{v^2 + 2 c v} = b b \); which is a general theorem.

In order to adapt this formula to the case of rivers, we must make \( l \) (the length) infinite; by which \( b \) becomes \( \frac{1}{a l} \) and \( b b = \frac{d}{a} \times \frac{b}{l} = \frac{d}{a} \); \( l \) being the sine of the inclination of the surface of the water, and \( d = 4 \) times the hydraulic mean depth. The hydraulic mean depth is the area of the section of the moving water, divided by as much of the circumference of that area, as the water touches. And since \( c \) is here \( \frac{c}{a} \),

\( v = \sqrt{a d s + e^2} - c \); and in most rivers, \( v \) becomes nearly \( \sqrt{10000 \times d s} \).

Another useful rule by Dr. Young, is to find the superficial velocity of the water in a river by adding to the mean velocity
velocity of a river its square root; this gives the velocity at the surface; and by subtracting the same square root, we get the velocity at the bottom.

N.B. \(2.618 - \sqrt{2.618} = 1\), and \(0.382 + \sqrt{0.382} = 1\); which it may be useful to remember, with reference to this last rule.

Dr. Young made a comparison of his general theorem, as above, with forty experiments extracted from the collection which served as a basis for Du Buat's calculations; and he found that the mean error of his formula is \(\frac{1}{7}\)th of the whole velocity, and that of his own \(\frac{1}{7}\)th only. But, omitting the four experiments, in which the superficial velocity only of a river was observed, and in which he calculated the mean velocity by Du Buat's rules, the mean error of the remaining 36 is but \(\frac{1}{7}\)th, according to Dr. Young's mode of calculation, and \(\frac{1}{7}\)th according to M. Du Buat's; so that, on the whole, the accuracy of the two formulæ may be considered as precisely equal with respect to these experiments.

In the six experiments which Du Buat has wholly rejected, the mean error of his formula is about \(\frac{1}{7}\)th, and that of Dr. Young's \(\frac{1}{7}\)th. In fifteen of Gerstner's experiments, the mean error of Du Buat's rule is \(\frac{1}{7}\)th, that of Dr. Young's 4th; and in the three experiments which Dr. Young made with very fine tubes, the error of his own rules is \(\frac{1}{7}\)th of the whole; while in such cases Du Buat's formulae completely fail.

It would be useless to seek for a much greater degree of accuracy, unless it were probable that the errors of the experiments themselves were less than those of the calculations. But if a sufficient number of extremely accurate and frequently repeated experiments could be obtained, it would be very possible to adapt Dr. Young's formula still more correctly to their results.

In order to facilitate the computation, Dr. Young made tables of the co-efficients \(a\) and \(c\) for 44 different values of \(a\), both in French and English inches, which may be seen in the Philosophical Transactions for 1808; but instead of inferring them, we shall give a far more extended table, which we have carefully deduced from Dr. Young's formula and table, and put it in a form more directly applicable to practice.

Let \(d\) represent four times the hydraulic mean depth of an open canal.

Note.—The hydraulic mean depth is the area of the section through which the water runs, divided by so much of the circumference of that section as is touched by the water.

Note also.—In case of close pipes running a full bore of water, the diameter of the pipe is four times the hydraulic mean depth.

\(s\) represents the sine of the inclination of the water's surface; that is, the height of the head or rise, divided by the length or distance of the slope in which such rise takes place.

\(v\), the mean velocity per second, in inches.

The other symbols used in the theorem are shown at the head of the different columns of the Table.

Dr. Thomas
Dr. Thomas Young's Theorem, with a new and enlarged Table deduced therefrom, expressly for our Work, for calculating the Velocity of Water flowing in Rivers, Channels, or Pipes.

Theorem. The mean Velocity per Second, in inches or \( v \), is 

\[
\sqrt{\frac{d}{a} \cdot \frac{c^2}{a^2}} - \frac{c}{a}
\]

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Use of the Table.—To render this theorem useful to those who are not familiar with the use of algebraic expressions, we shall give an example of the manner of calculating a stream of water, all the operations being performed by common arithmetic, with the help of the preceding Table.

1. If it is a stream of water running in an uniform channel, take a sufficient number of dimensions of the transverse section of the channel, and by the rules of menuration calculate the area of its cross section in square feet. Calculate also, how much of the circumference of such cross section is touched by the water, not including its level top.

Then divide the area in square feet by that portion of the circumference in feet, in order to obtain the hydraulic mean depth; this must be multiplied by 12, to reduce it to inches. Multiply the quotient by 4, and the result is $d$, the number which is to be fought in the first column of the preceding Table.

If it is a circular pipe of uniform bore, running full of water, its internal diameter, taken in inches, is already equal to four times the hydraulic mean depth, without any computation; and accordingly the diameter of the pipe in inches is to be fought for in column 1.

2. By a spirit-level or otherwise, ascertain the perpendicular fall or difference of level, between any two distant points on the surface of the water, if it is an open stream, and find the distance between these points of levelling, by measuring upon a parallel to the surface of the stream. These may be taken in any convenient measures; but the fall and the distance must be reduced to the same measures: then divide the fall by the distance, and the quotient is $s$, or a decimal number, which is the sine of the inclination of the stream.

If it is a close pipe, the perpendicular fall must be the difference of level between the surface of the referroir and the place of discharge; divide this by the length of the pipe.

3. Having found $d$, in column 1 of the Table, take out the number opposite to it in the second column, entitled $\frac{d}{a}$ (that is, $d$ divided by $a$), and multiply this tabular number by the decimal number $s$.

Note.—It will sometimes happen that the exact amount of $d$ is not to be found in column 1, but it will fall between two of the numbers therein; then take out the leaf of those numbers before $d$, and find how much is to be added thereto, by the following rule: Take the difference of the two numbers in column 1, between which $d$ falls; also the difference of the numbers opposite to them in column 2; also take the difference between the number $d$, and the leaf of the two numbers between which it falls. Now, by the Rule of Three, say, as the whole difference of the two numbers in column 1, is to the fame in column 2, so is the difference between $d$ and the number above it in column 1, to a fourth number, which is the proportional part to be added to the number of column 2, before $d$.

4. Take out the tabular number from column 3, which is entitled $\frac{e^2}{a^2}$, (that is, the square of $e$ divided by the square of $a$).

But here note, in case of calculating a proportional part, (as directed in the last rule,) it is not always to be added as in column 2; but sometimes, on the contrary, it is to be subtracted, accordingly as the numbers in that part of column 3 are increasing or decreasing; and for greater ease of discovering this, $a^2$ is placed opposite 14, and between 200 and 300 of column 1, to shew the places where these changes take place, from decrease to increase, and the contrary.

5. Multiply $\frac{e^2}{a^2}$, the result of the second operation, and $\frac{d}{a}$, the result of the third operation, together, and to the product add $\frac{e}{a}$, as found by the fourth operation; then extract the square root of this sum.

6. Take out $\frac{c}{a}$ from column 4, and apply the proportional part as before, if necessary; deduct this number $\frac{c}{a}$ from the square root last found, and the remainder or result is the mean velocity of the stream in inches per second, which was required.

Should this result be afterwards wanted in feet per minute, the numbers last obtained must be multiplied by 60, and divided by 12; or rather, multiplied at once by 5, which is the same thing.

To obtain the quantity of water discharged in a minute, multiply the area of the section of the stream by the velocity now found; taking care, if the area is in square feet, to express the velocity of the water in feet; or if the area is in square inches, the velocity must be expressed in inches, and the product or result will be in cubic feet or cubic inches accordingly.

Example 1.—The Academy of Sciences at Paris were occupied, during several months, with an examination of a plan proposed by M. Parcierus, for bringing the water of Yvette into Paris; and, after the most mature consideration, gave in a report of the quantity of water which M. De Parcierus's aqueduct would yield. Their report was afterwards found erroneous in the proportion of at least 2 to 5; for when the waters were brought in, they exceed the report in this proportion. Indeed, long after the giving in the report, M. Perronet, the most celebrated engineer in France, affirmed, that dimensions propos'd were much greater than necessary; and said that an aqueduct of $\frac{5}{4}$ feet wide, and $\frac{3}{2}$ deep, with a slope of 15 inches in a thousand fathoms, would have a velocity of 12 or 13 inches per second, and would bring all the water furnished by the proposed sources. The great diminution of expense occasion'd by the alteration, encouraged the community to undertake the work. It was accordingly begun, and partly executed. The water was found to run with a velocity of near 19 inches, when it was $\frac{3}{8}$ feet deep.

M. Perronet founded his computation on his own experience alone, acknowledging that he had no theory to instruct him.

Let us examine this case by our theorem.

First, The area of the section is $3.5$ feet deep $\times$ by $5.5$ feet wide $= 19.25$ square feet.—The circumference which the water touches, consists of the two fides of $3.5$ feet each, added to $5.5$ feet, the bottom $= 12.5$ feet. The area $19.25$ square feet divided by $12.5$ feet gives $1.54$ feet, for the hydraulic mean depth $\times 12 = 18.48$ inches; four times this is $d = 73.92$, which we are to seek in the first column of the table; and may take 74.

Secondly, To find $s$, take the fall 15 inches, or $1.33$ feet, and divide it by the distance, 1000 fathoms, or 6000 feet; the result is $0.00022$, for $s$, or the sine of the inclination.

Take out from the table the numbers corresponding to 74.

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<td>74</td>
<td>1875000</td>
<td>4.872</td>
<td>2.207</td>
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</table>

We
WATER.

We now have all the necessary quantities for making the calculation thus: multiply $\frac{d}{a} = 1875000$ by $s = .00022$, and we have $416.25$. To this add $\frac{c}{a} = 4.872$, and it makes $421.122$, of which extract the square root, and it is $20.52$; deduct $\frac{c}{a} = 2.207$ from this, and it leaves $18.313$ inches per second for the mean velocity of the water.

This agrees pretty well with the observation of 19 inches, and Dr. Robibon made very nearly the same result by a different mode of calculation.

The velocity of 18.313 inches per second $\times 5$ gives 91.56 feet per minute, and again multiplied by 10.25 square feet, (the area of the section,) gives 1761.6 cubic feet of water which flow through this canal every minute.

This example is comparatively easy, because the table affords the numbers required; but in some cases the exact numbers cannot be found in the table, we shall therefore give another example.

Example 2.—Mr. Watt measured a canal in the neighbourhood of Birmingham, which was 18 feet wide at the surface of the water, 7 feet wide at the bottom, and 4 feet deep. The water had a velocity of four inches in a mile; —required the velocity with which the water moved, and the quantity which the canal afforded.

To have a complete knowledge of the section, find the length of each sloping side, thus take the projection of the top width over the bottom width on each side, that is, half the difference between the top and bottom width $(18 - 7 \div 2) = 5.5$ feet; now the square of 5.5 is $30.25$, and the square of 4 feet the depth is 16, the sum of the two is $(30.25 + 16) = 46.25$; and the square root of this is 6.8, the length of the sloping side.

First, To find the area and the hydraulic mean depth.—
The mean between the widths of the top and bottom is $(18 + 7 \div 2) = 12.5$ feet deep $= 50$ square feet for the area of the section.

To find the circumference which the water touches, add the two sloping sides, each 6.8 feet, to 7 feet, the width of the bottom, and it makes 20.6 feet. The area, 50 square feet, divided by 20.6 feet, gives $2.4272$ feet $= 29.126$ inches for the hydraulic mean depth; 4 times this is 116.524, which is $d$, and must be found in the first column of the table. The nearest which can there be found is 100 inches.

Secondly, The fall is 4 inches in the distance of a mile, $= 63360$ inches, divide 4 by 63360, and it gives .00006313 for $s$, the sine of the inclination.

Thirdly, The value of $\frac{d}{a}$, in the second column, opposite to 100 in the first column, is 2501000, to which something must be added for the 16.5 inches. To find this quantity, take the difference between the adjacent numbers in column two, viz. 2501000 and 4950000 $= 2449000$, and, lastly, the difference between 100 and 116.5 $= 16.5$; then say, as 100 is to 2449000, so is $16.5$ to 409805, which number is to be added to 2501000, $= 2905085$, which is $\frac{d}{a}$ for 116.5.

Fourthly, The value of $\frac{c}{a}$, in column third opposite to 100, is 5.272, to which add .0043, as found by a rule of Vol. XXXVIII.

Fifthly, Multiply $s = .00006313$ by 2905085, and it gives 183.395; add $\frac{c}{a}$, or 5.276, as found by the preceding operation, and it gives 188.671; and the square root of this number is 13.736.

Sixthly, The value of $\frac{c}{a}$, in column fourth, is 2.296 for 100, or for 116.5 it is 2.297; deduct this from 13.736, the result of the last operation, and we have 11.439, which is the velocity of the stream in inches per second, and this $\times 5 = 57.195$ feet per minute. To find the quantity, multiply the velocity, 37.19 feet per minute, by 50 square feet the area, and we shall have 2859.7 cubic feet, which quantity will flow every minute through this canal.

The velocity here found is considerably smaller than what was observed by Mr. Watt; he found the velocity at the surface 17 inches per second, and at the bottom 10 inches, the mean velocity we have already calculated at 13.32.

Dr. Robibon, in the Encyclopaedia Britannica, gives a calculation of this same cafe by Du Bois's formula, which we have given in the article RIVER. He makes the velocity 11.85 feet per second, which differs to little from our computation, that the two theorems may be considered equally accurate; but both appear, by Mr. Watt's observation, to be rather too small in very small declivities of rivers and canals. This is not surprising when we consider, that the experiments, which are the foundation of both theseformulae, were made on small canals; but for this reason, we may expect they will be more accurate when applied to smaller channels, such as mill-courfes, aqueducts, &c.

In taking observations to apply this method of calculation to practice, it must be recollected that it always proceeds on the supposition, that the canal is of a regular width and depth, and of an uniform slope throughout. If this is not the case, the canal must be considered in different portions, and each calculated separately. We think greater accuracy will be attained by measuring and carefully levelling 100 yards in which the width and depth are quite regular, than by taking a mile in length, if there are any irregularities in the dimensions, or in the slope in that distance.

On the other hand, the theorem cannot apply at all, unless the length of the channel is such, that the water in it will arrive at an uniform motion without any acceleration of the motion, as it proceeds down. In short and rapidly inclined channels, the water accelerates in consequence of descending further down the fall; but when the canal is long, the velocity arrives at a certain point, and then the friction prevents any farther acceleration; in this case, the theorem applies. We shall not err sensibly in using this theorem for canals of 30 yards in length, or less, if the fall is small.

Method of gauging the Water running through close Pipes.—Dr. Young's theorem and our table, apply with equal, perhaps greater accuracy, to the case of close pipes than to open canals.

All that is necessary is, to measure the internal diameter of the pipe in inches, the length of the pipe, and the difference of the level between the water in the reservoir and the place at which the water is discharged, and proceed as in the former instance; but to render it more clear we shall give two examples.

Example 1.—The city of Edinburgh is supplied with water,
water, from springs at Comiston, which is a considerable distance; this is conveyed by two pipes, the first of which was laid in 1720, under the direction of Desaguliers. Dr. Robison mentions one of them, which is 5 inches diameter, 14,637 feet in length; the reservoir at Comiston is forty-four feet higher than the reservoir on the Castle-Hill, in the town of Edinburgh.

First, to find the fine of the inclination, or $i$, divide the fall 44 feet by 14,637, and it gives .00301, which is $i$.

Now take five inches, the diameter of the pipe in col. 1., and opposite to it in col. 2. find $\frac{d}{a} = 159700$, which multiply by .00301, gives 479.1, to this add $\frac{e^2}{a^2} = 2.624$ taken from the third column, and the sum is 483.724.

Extract the square root of this, and it is 21.948, from which deduct $\frac{c}{a}$, or 1.620, taken from col. 4., and the result is 20.328, which is the velocity in inches per second, and this $x$ by 5 = 101.64 feet per minute.

To find the quantity, find the area of the section of the pipe in square feet, by dividing the square of the diameter 25 by 183.3, and it gives .1304 square feet, and this $x$ by 101.64 feet per second, gives 13.86 cubic feet per minute for the discharge from the pipe.

Dr. Robison’s calculation of this same case by Du Buat’s formula, gives a velocity of 20.08 inches per second.

In Mr. Smeaton’s Reports, we find the other pipe fitted at four and a half inches bore, and that it yielded 160 Scots pints per minute, each 103.4 cubic inches = .058 cubic feet. Mr. Smeaton’s own calculation was 159 pints.

Example 2.—Mr. Smeaton states, that this pipe was improved by obtaining an increase of fall, making it 51 feet, and that it then yielded 200 Scots pints = 11.08 cubic feet per minute, the bore being 4½ inches, and the length 14,637 feet as before. Mr. Smeaton’s calculation was 173 pints = 10.36 cubic feet per minute. What would it be by Dr. Young’s theorem? viz. velocity =

$$\sqrt{\left(\frac{d}{a} \times \frac{e^2}{a^2} + \frac{c^2}{a^2}\right) - \frac{c}{a}}$$

To find $i$, divide the fall 51 feet by the length 14,637 feet; it gives .003484.

To find $\frac{d}{a}$, answering to 4.5 inches in col. 1., take half the difference between the numbers in the second column opposite to 4 and 5, and add it to the number answering to 4; thus, $\frac{d}{a}$ for 4 is 131560, and $\frac{d}{a}$ for 5 is 159700, difference 28140, which $\div 2 = 14100$, and this $x$ 131560 = 145600, which is $\frac{d}{a}$ for 4.5. Multiply this 145600 by $i$, or .003484, and it is = 507.67: to this add $\frac{e^2}{a^2}$.

To find $\frac{e^2}{a^2}$ for 4.5, take half the difference between the numbers in the third column for 4 and 5, which is .860, and subtract it from 4.363; the number answering to 45 the result is 3.494, which is $\frac{e^2}{a^2}$ for 4.5; this added to 507.67 is 511.164.

The square root of that number is 22.609, from which deduct $\frac{c}{a} = 1.854$, and it leaves 20.755, which is the velocity per second in inches.

(Note. $\frac{c}{a}$ is found by subtracting half the difference between the numbers for 4 and 5 in the fourth column, from the number answering to 4.)

20,755 inches per second $\times 5 = 103,775$ feet per minute, for the velocity. The area of the pipe is 4.5 $\times$ 4.5 = 20.25 circular inches, which = 183.3, the circular inches in a square foot, is = .1104 square feet for the area of the pipe. Multiply this by 103,775 feet per minute, and we get 11,46 cubic feet per minute for the discharge, which agrees very nearly with the experiment.

Dr. Brewster, in his Encyclopaedia, has calculated this same pipe, except that he states it 300 feet longer; he makes the velocity by Du Buat’s theorem 20.385 inches per second, and says that on an average of five years, from 1733 to 1742, its maximum discharge was 11.3 cubic feet per minute, he has also calculated the same pipe by five different formulae; thus,

<table>
<thead>
<tr>
<th>Scott’s Pints per Minute</th>
<th>Cubic Feet per Minute</th>
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</thead>
<tbody>
<tr>
<td>200</td>
<td>11.968</td>
</tr>
<tr>
<td>180.4</td>
<td>11.333</td>
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<td>189.77</td>
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<tr>
<td>180.7</td>
<td>10.813</td>
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<tr>
<td>173.0</td>
<td>10.352</td>
</tr>
<tr>
<td>191.5</td>
<td>11.459</td>
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</tbody>
</table>

It is satisfactory to find the results of so many different processes agree so nearly, and gives us great confidence in the truth of the principles. There is in this case so little difference amongst the theorems that any one may be taken; but we think it needless to enter into further particulars, as the one which we have given effects all that can be desired, and by the help of the table, is the most ready in the application.

We shall only add Mr. Smeaton’s table on the friction of water running through pipes, which we find in his manuscript papers, and which he computed from his own observations alone, without knowing the experiments on which the other theorems are founded. They will give rather less than the theorems, and perhaps may approach more nearly to actual practice, in which pipes are not laid with the same care, to avoid roughnesses within and sudden bends, as when prepared parcell by experiment; we may consider the theorems as the maximum discharge, and Mr. Smeaton’s table as the fair average of practice.

Use of the Table.—Find the velocity of the water per minute in feet and decimals in the first column, or in feet per second in the next column, and on the same line underneath the diameter of the bore in inches, you will find the perpendicular height of a column of water in inches and tenths, necessary to overcome the friction of that pipe for 100 feet in length, and obtain the given velocity.

Mr.
Mr. Smeaton's Table for showing the Friction of Water in Pipes; the Bore of the Pipe being given, and the Velocity of the Water therein; the Column or Height of Head necessary to overcome the Friction, and produce that Velocity, is shewn by this Table for 100 Feet in Length.

<table>
<thead>
<tr>
<th>Velocity.</th>
<th>Bore of the Pipes in Inches.</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>½</td>
</tr>
<tr>
<td>In Feet per Minute.</td>
<td>142.0</td>
</tr>
<tr>
<td>In Feet per Second.</td>
<td>142.0</td>
</tr>
</tbody>
</table>

Depths of Water necessary to overcome the Friction of the Water in a Pipe 100 feet long, and produce the Velocities marked in the two first Columns.
Mr. Smeaton's Table for the Friction in Water in Pipes—Continued.

<table>
<thead>
<tr>
<th>Velocity (In Feet per Minute)</th>
<th>Bore of the Pipes in Inches</th>
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<tbody>
<tr>
<td></td>
<td>4</td>
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<td>5</td>
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<td>275</td>
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<td>280</td>
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<tr>
<td>285</td>
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<tr>
<td>300</td>
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</tbody>
</table>

Bore of the Pipes in Inches.
We have searched in Mr. Smeaton's papers for the experiments by which this table was made, and find an investigation, from the experiments of M. Couplet, as recorded by Belidor, on the flow of water through a large pipe at Versailles. From these he deduced the following rule, to find the height of column in inches, corresponding with the velocities in inches per second, through a pipe of any diameter given in inches, and 100 feet long. 

$$48 \times (\text{velocity}) + \text{velocity}^2 \times \frac{52.66}{(\text{diameter})} = \text{depth of column}$$

or, still more nearly, taking 47.873 for the constant number instead of 48.

It appears that he found this rule did not agree with his own observations; and, in consequence, he made the following experiments himself with a pipe of 1 1/8 inch bore and 100 feet in length; and we believe he arranged them into the table, by projecting and drawing a curve, at least we find that was his usual method in like cases.

<table>
<thead>
<tr>
<th>Velocity per Second</th>
<th>Depth of the Column</th>
</tr>
</thead>
<tbody>
<tr>
<td>By the Table</td>
<td>By Experiment</td>
</tr>
<tr>
<td>Inches</td>
<td>Inches</td>
</tr>
<tr>
<td>6</td>
<td>2.1</td>
</tr>
<tr>
<td>7 1/4</td>
<td>3.0</td>
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<tr>
<td>8 1/4</td>
<td>3.7</td>
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<tr>
<td>10</td>
<td>4.7</td>
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<tr>
<td>11 1/4</td>
<td>6.2</td>
</tr>
<tr>
<td>13 1/4</td>
<td>7.9</td>
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<tr>
<td>15 1/4</td>
<td>10.4</td>
</tr>
<tr>
<td>18 1/4</td>
<td>14.7</td>
</tr>
<tr>
<td>21</td>
<td>18.3</td>
</tr>
<tr>
<td>23 1/4</td>
<td>22.7</td>
</tr>
<tr>
<td>27</td>
<td>28.4</td>
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<tr>
<td>28 1/4</td>
<td>30.8</td>
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<tr>
<td>29 1/4</td>
<td>33.8</td>
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<tr>
<td>30 1/4</td>
<td>34.8</td>
</tr>
<tr>
<td>35 1/4</td>
<td>47.2</td>
</tr>
<tr>
<td>43 1/4</td>
<td>71.2</td>
</tr>
</tbody>
</table>

Sir Isaac Newton, in his Principia, book ii. theo. 8. prob. 36. has demonstrated, that the velocity of water, flowing through holes in the bottom or side of a vessel, ought to be equal to the velocity which a heavy body would acquire, in falling through a space equal to the distance between the surface of the water and the place where it is discharged.

Hence, at the depth of 16 1/4 feet, a stream of 324 feet in length, ought to flow out in a second of time. And from the laws of falling bodies, it follows, that as the square root of 16 1/4 is to the velocity of the stream flowing out at that depth, so is the square root of any other depth to the velocity of that depth.

Hence, the velocity of water flowing out of a horizontal aperture, in the bottom of a cistern or reservoir, is as the square root of the height, or the depth of water above the aperture.

That is, the pressure, and consequently the depth, is as the square of the velocity; for the quantity flowing out in any given time is as the velocity, and the force required to produce a velocity in a certain quantity of matter in a given time, is also as that velocity; therefore, the force must be as the square of the velocity.

The proposition is fully confirmed by Boffut's and Michelotti's experiment; the proportional velocities, with a pressure of 1, 4, and 9 feet, being 2722, 5436, and 8135, instead of 2722, 5444, and 8166; very inconsiderable differences.

There is another mode of considering this proposition, which is a very good approximation. Suppose a very thin cylindrical plate of water, like a wafer, situated in the orifice; and suppose a constant succession of such plates to be put in motion, one at every instant, by means of the pressure of the whole cylinder standing upon it; let all the gravitating force of the column be employed in generating the velocity of each small cylindrical plate, (neglecting the motion of the cylinder itself,) this plate would be urged by a force as much greater than its own weight, as the column is higher than itself, and this through a space shorter in the same proportion than the height of the column. But where the forces are inversely as the spaces described, the final velocities are equal; therefore, the velocity of the water flowing out must be equal to that of a heavy body falling from the height of the head of water.

This velocity may be found very nearly by the rule which we have before given in underfoot water-wheels, or by extracting the square root of the depth in feet, and multiplying it by 48 1/2: the product is the velocity per minute in feet.

In practice it is more convenient to take the depth in inches, instead of feet; then to obtain the velocity in feet per minute.

Extract the square root of the depth in inches, and multiply it by 138.88: the product is the velocity in feet per minute.

As this rule is the foundation of all calculations for velocities, when friction is not considered, it is constantly wanted: we shall, therefore, give a table, calculated by Mr. Smeaton from the above rule, shewing the theoretic velocities corresponding with different depths.
A Table shewing the Velocity in Feet per Minute, or per Second, with which Water should issue from an Aperture at any given Depth beneath the Surface, from \( \frac{1}{2} \) Inch to 20 Feet, calculated according to the Theory of falling Bodies.

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</thead>
<tbody>
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<td>( \frac{1}{2} )</td>
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<td>0.04</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \frac{1}{64} )</td>
<td>( \frac{1}{64} )</td>
<td>0.02</td>
<td>( \frac{1}{64} )</td>
<td>( \frac{1}{64} )</td>
<td>0.02</td>
<td>( \frac{1}{64} )</td>
<td>( \frac{1}{64} )</td>
<td>0.02</td>
<td>( \frac{1}{64} )</td>
<td>( \frac{1}{64} )</td>
<td>0.02</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \frac{1}{128} )</td>
<td>( \frac{1}{128} )</td>
<td>0.00</td>
<td>( \frac{1}{128} )</td>
<td>( \frac{1}{128} )</td>
<td>0.00</td>
<td>( \frac{1}{128} )</td>
<td>( \frac{1}{128} )</td>
<td>0.00</td>
<td>( \frac{1}{128} )</td>
<td>( \frac{1}{128} )</td>
<td>0.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:** The table continues with similar entries for various depths and velocities.
If we were to calculate the expence or discharge for any orifice by this table, we should in every instance find a much greater than nature really gives us.

It must be recollected, that this table is not calculated from experiment, but from the theory of falling bodies, which makes no allowance for the loss of velocity, which arises from the friction of the particles of water against the edges of the aperture, and against the neighbouring particles of water which are not put in motion.

Sir Isaac Newton, in making experiments, found the velocity thus determined to be too great, which in one case he corrected. The friction against the sides of the aperture, and the oblique direction of the particles of water before they reach the aperture, both tend to diminish the velocity of the stream; and if these causes could be removed, especially the latter, the Newtonian theory would be confirmed by experiment, or rather experiment would exactly agree with theory.

For, if we suppose water running into the top of a cylindrical tube, and that there is no attraction or friction between the particles of water and the interior of the tube, the velocity of the water, or of each of the particles at the bottom, would be the same, or equal to that to which they would have acquired in falling through the same space without the tube, towards the earth.

Hence, to obtain the true velocity, under different circumstances, we must correct the computed velocity by experiments.

It is flated in some elementary works on hydrostatics, that the velocity of the water at the orifice is only equal to that which a heavy body would acquire by falling through half the height of the fluid above the orifice. This was first maintained by Sir Isaac Newton, who found that the diameter of the stream is contracted, after it has quitted the orifice; and at the smallest part, the diameter was to that of the orifice as 21 to 25. The area, therefore, of the one was to the area of the other as 21$^2$ to 25$^2$, which is nearly the ratio of 1 to the square root of 2. By measuring the quantity of water discharged in a given time, and also the area of the vena contracta, Sir Isaac found, that the velocity at the vena contracta was that which was due to the whole altitude of the fluid above the orifice. He, therefore, concluded, that since the velocity of the orifice was to that at the vena contracta as 1 to the square root of 2, the velocity in the vena contracta was that which was due to the whole altitude of the fluid; and that the velocity at the orifice must be that which is due to one half that altitude, because the velocities are as the square roots of the heights.

From this, Sir Isaac flated the actual velocity of flowing water to be $\frac{177}{255}$, or .707 of the theoretic velocities.

But the real quantity of the reduction varies in different cases, according to the nature of the aperture: hence, it is necessary to consider all different forms of apertures, and make a different allowance for each case. To do this, the circumstances of the aperture must be carefully examined.

A, fig. 8. Plate II. Water-work, explains the manner in which the filaments of water may be suppoed to move, when a stream flows through an aperture in a thin plate.

B shews the motion, when a tube of about two diameters in length is added to the orifice, and when the water flows through the tube with a full stream. This does not always happen in fo short a pipe, and never in one that is shorter; but the water will frequently detach itself from the sides of the pipe, and flow through it with a contracted jet.

C shews the motion, when the pipe projects into the inside of the vessel. In this case, it is difficult to make the tube flow full.

D represents a mouth-piece fitted to the hole, and formed agreeably to that shape which a jet would assume of itself. In this case all contraction is avoided, because the mouth of the pipe may be considered as the real orifice; and nothing now diminishes the discharge but a trifling friction of the sides.

When water issues through a hole in a thin plate, the lateral columns, falling into the hole from all sides, cause the issuing filaments to converge to the axis of the jet, and contract its dimensions after it has quitted the hole, and at a little distance from the hole; and it is in this place of greatest contraction that the water acquires that velocity which we assume as equal to that acquired by falling from the surface: therefore, that our computed discharge may be in agreement with observation, it must be calculated on the supposition that the orifice is diminished to the size of this smalles section. But the contraction is subject to variations, of which the reasons are not apparent.

The following are the measures of the contracted vein, as ascertained by different authors; the area of the aperture being 1000, the area of the contracted vein at the smallest will be as follows:

<table>
<thead>
<tr>
<th>Author</th>
<th>Area (feet^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sir Isaac Newton</td>
<td>- 707</td>
</tr>
<tr>
<td>Poleni</td>
<td>- 714</td>
</tr>
<tr>
<td>Greatest found by Boffut</td>
<td>- 627</td>
</tr>
<tr>
<td>Mean of six experiments by Boffut</td>
<td>- 654</td>
</tr>
<tr>
<td>Lowest found by Boffut</td>
<td>- 667</td>
</tr>
<tr>
<td>Bernoulli</td>
<td>- 651</td>
</tr>
<tr>
<td>Michelotti</td>
<td>- 641</td>
</tr>
<tr>
<td>Du Bust</td>
<td>- 666</td>
</tr>
<tr>
<td>Venturi</td>
<td>- 636</td>
</tr>
<tr>
<td>Eytelwein</td>
<td>- 642</td>
</tr>
</tbody>
</table>

The measures given by Boffut were taken by a pair of spherical compasses, with which he measured directly the diameter of the contracted vein, which he found to prefer the same diameter for some lines. The altitude of the water in the reservoir which Boffut used was 12 feet 6 inches. He measured the vena contracta also, when the water issued by vertical orifices placed 4 feet 3 inches below the surface of the fluid, and he obtained the very fame results. The ratio between the area of the orifice and the area of the vena contracta appears from the above, to be by no means constant. It undergoes perceptible variations, by varying the form and position of the orifice, the thickefs of the plate in which the orifice is made, the form of the vefsel, and the velocity of the issuing fluid.

The dimensions of the smallest section of the contracted vein are at all times difficult to be ascertained with precision. It is, therefore, much more convenient to compute from the real dimensions of the orifice, and to correct this computed discharge by means of an actual comparison of the computed and effective discharges, in a series of experiments made in situations resembling those eases which most frequently occur in practice.

We have made a collection of experiments by various authors, and from them we have deduced the following rule for the real velocity with which water issues from an aperture in a thin plate.

**Rule.**—Measure the depth of the centre of the orifice beneath the surface of the water in the reservoir in inches, extract its square root, and multiply it by the constant number 85.87: the product is the velocity in feet per minute.

If the velocity, as marked in the preceding table, is multiplied by .618, the same result will be obtained. For the contraction of the stream or vein of water, running out of a simple orifice in a thin plate, reduces the area of its section, at
at the distance of about half its diameter from the orifice, from 1 to .665, according to the mean different statements above quoted: hence the diameter is reduced to .815.

The quantity of water discharged is very nearly, but not quite, sufficient to fill this cistern with the velocity due, or corresponding to the height. For finding accurately the quantity discharged, the area of the orifice must be supposed to be further diminished to .619 on account of friction.

In regard to the accuracy of this rule, we must refer to the following table, which contains the results of 35 experiments, and also the calculation for each. We have been obliged to reject about 12 other experiments, because they would not accord with the theorem; but in nearly all of them, the velocity was greater than the rule, and those which are left we have preferred. This was done, because we suspect that many of the cases were not apertures in thin plates; but in wood planks of considerable thickness, such as sluices, the discharge would then be greater than our rule supposes, and such cases should be classed with another description of aperture.

<table>
<thead>
<tr>
<th>Authors</th>
<th>Depth in Inches of the Centre of the Orifice beneath the Surface</th>
<th>Velocity of the efficient Water per Minute Water in Feet</th>
<th>Velocity calculated, by multiplying the Square Root of the Depth by .8597</th>
<th>Description of the Aperture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smeaton and Brindley</td>
<td>12.5</td>
<td>327 +</td>
<td>309</td>
<td>1 inch square.</td>
</tr>
<tr>
<td>Boffut</td>
<td>12.8</td>
<td>307</td>
<td>307</td>
<td>2 1/2 circular</td>
</tr>
<tr>
<td>Poleni</td>
<td>22.7</td>
<td>381</td>
<td>410</td>
<td>1 inch square.</td>
</tr>
<tr>
<td>Smeaton</td>
<td>24.5</td>
<td>432 +</td>
<td>425</td>
<td>1 inch square.</td>
</tr>
<tr>
<td>Defaguilers</td>
<td>25.6</td>
<td>432</td>
<td>429</td>
<td>1 inch square.</td>
</tr>
<tr>
<td>Boffut</td>
<td>29.3</td>
<td>460</td>
<td>464</td>
<td>1 1/4 inch square.</td>
</tr>
<tr>
<td>Venturi</td>
<td>34.6</td>
<td>508</td>
<td>505</td>
<td>1 3/4 inch circular.</td>
</tr>
<tr>
<td>Boffut</td>
<td>38.4</td>
<td>531</td>
<td>532</td>
<td>1 3/4 inch circular.</td>
</tr>
<tr>
<td>Venturi</td>
<td>42.6</td>
<td>553</td>
<td>560</td>
<td>1 1/4 inch circular.</td>
</tr>
<tr>
<td>Smeaton</td>
<td>48.5</td>
<td>608</td>
<td>608</td>
<td>1 3/4 inch circular.</td>
</tr>
<tr>
<td>Boffut</td>
<td>51.2</td>
<td>613</td>
<td>615</td>
<td>1 3/4 inch circular.</td>
</tr>
<tr>
<td>Smeaton</td>
<td>60.6</td>
<td>680</td>
<td>687</td>
<td>1 inch square.</td>
</tr>
<tr>
<td>Boffut</td>
<td>64.7</td>
<td>751</td>
<td>752</td>
<td>3 inches square.</td>
</tr>
<tr>
<td>Michelotti</td>
<td>84.5</td>
<td>790</td>
<td>790</td>
<td>3 inches square.</td>
</tr>
<tr>
<td></td>
<td>86.5</td>
<td>807</td>
<td>798</td>
<td>1 inch square.</td>
</tr>
<tr>
<td></td>
<td>87.8</td>
<td>805</td>
<td>804</td>
<td>3 inches square.</td>
</tr>
<tr>
<td></td>
<td>87.9</td>
<td>803</td>
<td>805</td>
<td>3 inches square.</td>
</tr>
<tr>
<td></td>
<td>89.6</td>
<td>810</td>
<td>813</td>
<td>1 inch circular.</td>
</tr>
<tr>
<td></td>
<td>102.4</td>
<td>866</td>
<td>869</td>
<td>3 inches circular.</td>
</tr>
<tr>
<td>Boffut</td>
<td>115.</td>
<td>918</td>
<td>920</td>
<td>3 inches square.</td>
</tr>
<tr>
<td></td>
<td>128.</td>
<td>967</td>
<td>971</td>
<td>1 inch circular.</td>
</tr>
<tr>
<td>Michelotti</td>
<td>141.</td>
<td>1014</td>
<td>1019</td>
<td>1 inch circular.</td>
</tr>
<tr>
<td></td>
<td>148.3</td>
<td>1031</td>
<td>1045</td>
<td>3 inches circular.</td>
</tr>
<tr>
<td></td>
<td>149.2</td>
<td>1035</td>
<td>1049</td>
<td>3 inches square.</td>
</tr>
<tr>
<td>Boffut</td>
<td>150.</td>
<td>1050</td>
<td>1051</td>
<td>1 inch circular.</td>
</tr>
<tr>
<td></td>
<td>150.2</td>
<td>1055</td>
<td>1053</td>
<td>1 inch circular.</td>
</tr>
<tr>
<td></td>
<td>275.1</td>
<td>1438</td>
<td>1425</td>
<td>1 inch square.</td>
</tr>
<tr>
<td></td>
<td>276.4</td>
<td>1414</td>
<td>1428</td>
<td>3 inches circular.</td>
</tr>
<tr>
<td>Michelotti</td>
<td>277.7</td>
<td>1417</td>
<td>1431</td>
<td>3 inches square.</td>
</tr>
<tr>
<td></td>
<td>277.7</td>
<td>1410</td>
<td>1437</td>
<td>2 inches circular.</td>
</tr>
<tr>
<td></td>
<td>281.6</td>
<td>1446</td>
<td>1441</td>
<td>1 inch circular.</td>
</tr>
</tbody>
</table>

These are the results of the discharge through orifices in a thin plate. If we apply to the orifice the shortest cylindrical pipe, that will cause the stream to adhere every where to its sides, we shall find that its length must be twice its diameter. The discharge through such a tube will be about 1/4ths of the full quantity, and the velocity may be found by multiplying the full velocities marked in our first Table by .8125.

The greatest diminution of velocity is produced by interfering the pipe so as to project within the side of the reservoir; probably because of the greater interference of the motions of the particles approaching its orifice in all directions; in this case, the velocity is reduced nearly to half of the full velocity.

It was one great aim of the experiments of Michelotti and Boffut to determine the effects of contraction in different cases. Michelotti, after carefully observing the form and dimensions of the natural jet, made various mouth-pieces resembling
fembling it, till he obtained one which produced the smallest diminution of the computed discharge, or till the discharge computed for the area of its smaller end approached the nearest to the effective discharge. And he at last obtained one, which gave a discharge of 983, when the natural discharge would have been 1000. This piece was formed by the revolution of a trochoid round the axis of the jet, and the dimensions were as follow:

- Diameter of the outer orifice = 36
- Diameter of the inner orifice = 46
- Length of the axis = 96

Eytelwein states that a conical tube, approaching to the figure of the contraction of the stream, procured a discharge equal to .92 of the full velocity; and when its edges were rounded off, of .98, calculating on its least section.

Venturi has ascertained, that the discharge of a cylindrical pipe may be increased by the addition of a conical tube at the end of it nearly in the ratio of 5 to 2. (See his experiments in our article Discharge.) But Mr. Eytelwein finds this assertion somewhat too strong, and observes, that when the pipe is already very long, scarcely any effect is produced by the addition of such a tube. He made a number of experiments with different pipes, where the standard of comparison was the time of filling a given vessel out of a large reservoir, which was not always kept full, because it was difficult to avoid agitation in replenishing it; but this circumstance was rendered indifferent to the results of the experiments by the application of an ingenious theorem. They prove that a compound conical pipe may increase the discharge to twice and a half as much as through a simple orifice, or to more than half as much more as would fill the whole section with the velocity due to the height; but where a considerable length of pipe intervenes, the additional orifice appears to have little or no effect.

The results of the investigations of Boffut, Michelotti, and Eytelwein, agree in a very satisfactory manner respecting the diminution of the discharge in different cases; and we have arranged them in the following Table, which we recommend to engineers, as affording all the necessary information to calculate the discharge from sluices and orifices.
### Description of the Aperture through which the Water Flows.

**Note.** In taking the measure for the depth of the column which produces the velocity, we may in general take it from the surface of the water to the centre of the aperture; but if the aperture is in a perpendicular plane, and of a height greater than one-fourth of the whole depth, then the velocity must be found for the top of the aperture and also for the bottom of the aperture, and the mean of both taken for the mean velocity of the water.

<table>
<thead>
<tr>
<th>Description of the Aperture</th>
<th>Ratio of Velocity</th>
<th>Rule</th>
<th>To find the Velocity of the issuing Water</th>
<th>To find the Number of Cubic Feet of Water which flow per Minute through each Square Inch of the Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>For orifices in a thin plate</td>
<td></td>
<td></td>
<td>I. To find the Velocity in Feet per Second.</td>
<td>II. To find the Velocity in Feet per Minute.</td>
</tr>
<tr>
<td>For the openings of sluices or apertures in the side or internal walls of the reservoir, without any side walls which can serve to conduct the particles of water in a stream to the aperture</td>
<td>.618</td>
<td>4.957</td>
<td>1.431</td>
<td>297.45</td>
</tr>
<tr>
<td>For a short cylindrical pipe from two to four times as long as the bore,</td>
<td>.636</td>
<td>5.1</td>
<td>1.472</td>
<td>306.</td>
</tr>
<tr>
<td>1. When it projects within the vessel and does not run with a full bore of water, but in form of a contracted vein within the tube</td>
<td>.5137</td>
<td>4.119</td>
<td>1.190</td>
<td>247.14</td>
</tr>
<tr>
<td>2. When it projects within the vessel but runs with a full bore of water</td>
<td>.681</td>
<td>5.46</td>
<td>1.576</td>
<td>327.6</td>
</tr>
<tr>
<td>3. When it does not project within the vessel</td>
<td>.8125</td>
<td>6.515</td>
<td>1.881</td>
<td>390.9</td>
</tr>
<tr>
<td>For narrow openings, of which the bottom is on a level with that of the reservoir. Also for smaller openings of sluices, when provided with side walls to conduct the water to the aperture; also for the water-passage under bridges which have square piers with abrupt projections, which do not conduct the water regularly into the passage</td>
<td>.860</td>
<td>6.9</td>
<td>1.992</td>
<td>414.</td>
</tr>
<tr>
<td>For wide openings, of which the bottom is on a level with that of the reservoir; also for large sluices with conducting walls in the direction of the stream and for the water-way beneath bridges with pointed piers, which conduct the water into the passage</td>
<td>.960</td>
<td>7.7</td>
<td>2.223</td>
<td>462.</td>
</tr>
<tr>
<td>For a circular orifice or tube formed correspondent to the contracted stream</td>
<td>.983</td>
<td>7.884</td>
<td>2.276</td>
<td>473.04</td>
</tr>
<tr>
<td>For the whole velocity due to the height according to the theorems for falling bodies</td>
<td>1.000</td>
<td>8.019</td>
<td>2.3148</td>
<td>481.14</td>
</tr>
</tbody>
</table>
WATER.

To apply these rules for gauging sciuces, the following
measures mns be taken. 1. The perpendicular depth of
the bottom of the aperture beneath the surface of the
water. 2. The perpendicular depth of the top of the aperture.
3. The horizontal width of the opening. Then, taking the
difference between the two first measures leaves the height
of the opening.

Note.—If the aperture is not in a vertical plane, but
inclined, as is frequently the case in mill-scnuces, then
the width of the opening must be measured on the slope; but
the depths must always be taken perpendicularly beneath
the surface of the water.

To make the calculation, find the mean velocity of the
effluent water, by calculating the velocity due to the depth
of the top of the aperture, and also for the bottom of the
aperture, and take a mean of the two.

Note.—When the height of the aperture is less than
one-fourth of the whole depth, then the velocity due to the depth
of the centre of the aperture will be very near the truth.

Having found the mean velocity in feet, multiply it by
the number of square feet in the area of the aperture, and it
will give the quantity discharged, in cubic feet.

Example 1.—A sciuces, which is four feet wide, is opened
or drawn seven inches, and the depth of water above
the centre of the orifice is ten feet. The edges of the sciuces
are cut sharp, so that the borders of the orifice are like a
thin plate. What is the velocity and discharge per minute
in cubic feet?

The square root of 10 is 3.162, which x 297.45 from the
table, gives 940.6 feet per minute, for the mean velocity of
the water.

The area of the aperture is 4 feet, which x 7 inches, = 28+
12 = 2.333 square feet, for the areas of the aperture; there-
fore, multiply 940.6 by 2.333, and we have 2194 cubic feet
per minute, for the quantity discharged.

If the depth had been expressed in inches, it would have
been 120. The square root of this is 10.595, and this multipli-
d by 85.87, gives 940.6 feet per minute for the velocity, as
before. In like manner, the table gives the proper multipliers
for finding the velocity in feet per second, if it is required.

If it was only required to obtain the quantity discharged,
we may proceed more directly, thus. The depth is 10
feet, and the square root is 3.162, X by 2.065, the number
taken from the last column but one of the table, and we
have 6.529 cubic feet, which are discharged per minute
from every square inch of the aperture. The aperture is
48 inches, this x 7 = 336 square inches, this x 6.529 =
2194 cubic feet discharged as before.

If the depth had been 120 inches, then the square root of
that number is 10.595, and this x 5963, the number in the
last column gives 6.529, as the last.

Another method is, to calculate the theoretic discharge,
and then make a proper reduction, by multiplying by the
declimal number in the first column. Thus, by our first
table of velocities, 120 inches deep = 1521.8 feet per
minute, this x by 2.333 square feet, the area of the aperture
gives 3550 cubic feet per minute for the theoretic discharge.

The first column of the present table shews that the real
discharge is only .618 of the theoretic discharge; therefore,
multiply 3550 cubic feet by .618 = 2194 cubic feet for the
real discharge, as in all the former cases.

This latter method is very convenient, because we can
apply a different correction in different cases, according to
direction, and the table of velocities facilitates the calculation
very much.

Example 2.—A flour-mill was worked by the water
which ran through a shuttle four feet wide, the depth to the
bottom of the aperture was 22 inches, and the shuttle was
drawn up one inch and one-quarter, so that the depth to the
top of the aperture was 20.75 inches; what is the expendi-
ture per minute?

The full velocity due to 22 inches depth is by the table
651.6 feet per minute. Ditto —— for 20^ for 20.75
2184.3

642.15 mean velocity per min.

Note.—As 20.75 is not to be found in the table,
take 20 1/2 = 628.8, and add to it half the difference between
20 1/2 and 21, viz. 3.9 = 632.7 feet per minute velocity for
20.75, as above.

The area of the aperture 48 inches, x 1.25 inches = 60
square inches, - 144 = .4166 square feet. Multiply this
by the velocity = 642.15 feet, and it gives 267.5 cubic feet
per minute discharged according to theory.

To reduce this to the practical discharge, multiply by
some of the numbers in the first column of the Table oppo-
site, according to the nature of the aperture. The sciuces was
in a trough, nearly of its own dimensions; so that the bottom
and sides nearly corresponded with the aperture; therefore,
take .860, and x 267.5 gives 230 cubic feet per minute.

It is very convenient to an engineer to be able to calculate
the discharge of water by means of the slide-rule. This
he may do by means of the two lines usually marked C and
D; C being a line of logarithms, and D a line similarly
divided on a scale twice as large. By means of these, the
square root of any number can be extracted and multiplied by
any number at one operation. To use it, find the multi-
plier which is to be used, upon the line D, and set the
slider so that 10 upon C will correspond with it; then seek
for the depth upon C, and opposite to it upon D, the re-
quired velocity will be found.

Thus,

Line on the slider marked C, depth in inches, 10
Line on the rule marked D, velocity in feet per minute, 85.8

And in like manner for any other multipliers: for
instance,

Line on the slider marked C, depth in inches 10
Line on the rule marked D, cubic feet per minute
discharged through a .596
square inch,

Mr. Eytelwein observes, from Du Buat, that the discharge
through an orifice communicating between two reservoils,
and situated beneath the surface of the water in the lower
reervoir, is the same as if the water run into the open air,
taking the difference of level between the two surfaces, for
the depth of the column; he calculates the discharge when
the water has to pass through several orifices in the sides of
as many reservoils open above. In such cases, where the
orifices are small, the velocity in each may be conidered
as generated by the difference of the heights in the two
contiguous reservoils; and the square root of the difference
will therefore represent the velocity which must be generated
in the several orifices, inversely as their respective areas, so
that we may calculate from hence the heights of the different
reervoirs when the orifices are given. Mr. Eytelwein also
considers the case of a lock, which is filled from a canal of
an invariable height, and determines the time required, by comparing it with that of a vessel emptying itself by the
preffure of the water that it contains, obferving, that the
motion is retarded in both cafes in a fimilar manner, and
he finds the calculation agree sufficiently well with expe-
riment made on a large fcale.

Rules for measuring the Quantity of Water which fows over
a Weir, or through an Aperture in the Edge of a Board, the Stream
being open at Top.—If we fuppose water running in a regular
fheet over the edge of a large cifern or refervoir, or through
a rectan-gular aperture made in the perpendicular wall or
fide of the cifern, but open at top, we may take the area of
the aperture, and proceed to find the velocity by calcula-
tion.

When this fubjeft has been considered theoretically,
it has been assumed, that the surface of the water at
the place where it runs through the aperture, is with-
out motion, becaufe it ifands at the fame level with the
flagnant water in the refervoir, and that the velocity of
the water at different depths will always be as the
square root of the depth; that is, beginning at nothing at
the surface, the velocity at different depths will increafe
by that law.

We can find the velocity at the bottom of the aperture, or
at any intermediate depth, by the rules and table we have
already given; but what we require is the mean velocity of
the whole fheet of water. We could obtain this nearly by cal-
culating the velocities for a great number of different depths,
increafe by regular intervals, and taking a mean of the whole;
but we can eflct the fame with exaftnefs, if we take
two-thirds of the velocity at the bottom, and consider it as
the mean velocity of the whole body of water; or, the ve-
locity due to four-ninths of the depth, will give the fame
result.

In practice we muft make allowance for flos of motion by the
friction of the water in paffing through the aperture, and also
becaufe the water does not fill the aperture to the fame level
as the flagnant water in the refervoir. The motion of the
water extends fome diftance into the refervoir, and the water
will confequently have a ploping furface from that part of
the furface where the motion begins; the flope will con-
tinually increafe as the motion of the water accelerates, fo
as to form a convex furface, which is a portion of a para-
bolic curve; hence the furface of the water where it is
paffing through the aperture will be in rapid motion, in-stead of
being motionless as the theory fuppofes, and the furface will
be much lower than the furface of the flagnant water, fo
that the aperture will only be half full of water; at leaft this
is the allertion of M. Du Buat. But Dr. Robifon af-
ses, that he always found the depth of the water in the aperture
about .715 of the whole depth from the bottom of the ap-
erture to the level of the water in the refervoir.

M. Du Buat's theorem for the discharge through an open
aperture, when reduced to English meafures, is this: having
given the depth from the level furface of the water to the
bottom of the aperture, and alfo the width of the aperture
in inches, to find the discharge in cubic inches per feccord.

Let it be remembered that 11.4491 cubic inches of
water, or 11.5, will be discharged in a fecdond, through every
inch in width of the aperture, when the bottom of it is ex-
actly one inch beneath the level furface of the refervoir.
To obtain the discharge for any other depths, this number
muft be multiplied by the square root of the cube of the
depth in inches, and it will give the cubic inches difcharged
per fecdond through each inch in width of the aperture.

Example.—Suppose the depth of the bottom of the ap-
ture beneath the level furface of the water in the refervoir
to be 4 inches. The cube of this is 64, the square root of
which is 8; therefore, alth at that depth each inch in width will
difcharge 8 X 11.5 = 92 cubic inches per fecdond; if the
width of the aperture was 3 feet, then 92 X 36 inches
= 3312 cubic inches, or 1,917 cubic inches, which X 60 fec-
conds = 11502 cubic feet per minute.

Dr. Robifon gives the following table, which is rather
greater than from the above theorem, and will be found
very exact, when the aperture is made in a plank or
board half an inch or an inch thick, and fo figured that the
fides and bottom of the refervoir do not conform with the
edge of the aperture, to lead the particles of water in a
current to the aperture.

<table>
<thead>
<tr>
<th>Depth from the Bottom of the Aperture to the level Surface of the Water, in Inches</th>
<th>Cubic Feet discharged per Minute through each Inch of the Width of the Aperture</th>
</tr>
</thead>
<tbody>
<tr>
<td>In small Apertures of less than 18 Inches wide</td>
<td>In larger Apertures than 18 Inches.</td>
</tr>
<tr>
<td>1</td>
<td>0.403124</td>
</tr>
<tr>
<td>2</td>
<td>1.140</td>
</tr>
<tr>
<td>3</td>
<td>2.265</td>
</tr>
<tr>
<td>4</td>
<td>3.225</td>
</tr>
<tr>
<td>5</td>
<td>4.507</td>
</tr>
<tr>
<td>6</td>
<td>5.925</td>
</tr>
<tr>
<td>7</td>
<td>7.466</td>
</tr>
<tr>
<td>8</td>
<td>9.122</td>
</tr>
<tr>
<td>9</td>
<td>10.884</td>
</tr>
<tr>
<td>10</td>
<td>12.748</td>
</tr>
<tr>
<td>11</td>
<td>14.707</td>
</tr>
<tr>
<td>12</td>
<td>16.758</td>
</tr>
<tr>
<td>13</td>
<td>18.895</td>
</tr>
<tr>
<td>14</td>
<td>21.117</td>
</tr>
<tr>
<td>15</td>
<td>23.419</td>
</tr>
<tr>
<td>16</td>
<td>25.800</td>
</tr>
<tr>
<td>17</td>
<td>28.258</td>
</tr>
<tr>
<td>18</td>
<td>30.786</td>
</tr>
</tbody>
</table>

In taking the depth, if it does not exceed four inches, it
will not be exact enough to take proportional parts for the
fractions of an inch. The following method is exact: if
there be odd quarters of an inch, look in the table for as
many inches as the depth contains quarters, and take the
eighth part of the answer. Thus, for 32 inches take the
eighth part of 23.419, which corresponds to 15 inches.
This is 2.927.

If the aperture is not in the fide of a large refervoir, but in
a running stream, we muft augment the discharge, by mul-
tiplying the fection by the velocity of the fame. Bat this
 correction can seldom occur in practice, because in this case
the discharge is previously known.

The amount of the allowance for friction and flos of
motion muft be different in different cafes, according to the
kind of aperture, or board over which the water flows; but
will always be very nearly the fame, as the allowance, for flos
in an aperture or orifice of similar nature. For instance, if
the edges of the aperture through which the water runs be
a thin plate, then we may find the velocity in feet per
minute due to the whole depth from the bottom of the
notch to the level furface of the water in the refervoir; mul-
tiply the square root of the depth in inches by 85.87, as we
have
have before directed, and take two-thirds of the product for the mean velocity; this multiplied by the number of square feet in the area of the section of the aperture, will give the cubic quantity of water which flows per minute in cubic feet. Note, in taking the area of the section, we must measure the whole depth from the level surface, and multiply it by the horizontal width of the aperture, and not simply the section of the water. This is because, the theory upon which the rule is founded supposes the water in the aperture to have no velocity at the surface, and to be upon the level of the standing water. Neither of these suppositions is true in reality, but the result is very nearly true, because the section of the moving water is diminished in proportion to the velocity which the water has at the surface, and in consequnce the errors of the two assumptions always correct each other.

We have therefore only to apply a correct theorem to obtain the velocity due to the whole depth, according to the nature of the aperture, and take two-thirds of the product. All the necessary information for this purpose may be taken from the table of multipliers last given, for the velocity of the discharge through apertures; or otherwise, if we take the velocity at the bottom, and multiply it by the depth, and take two-thirds of the product, we shall have the mean velocity. But to make the subject clear we shall give another table for this object.

Rules for obtaining the Velocities and Quantities of Water discharged through rectangular Apertures, which are open at Top.

<table>
<thead>
<tr>
<th>Description of the Aperture.</th>
<th>To find the mean Velocity of the Water running through the Aperture in Feet per Minute.</th>
<th>To find the Number of Cubic Feet discharged per Minute through each Inch in Width of the Aperture.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Note.—The depths are supposed to be measured from the level surface of the water to the bottom of the aperture, in inches.</td>
<td>Rule.—Multiply the Square Root of the Depth in Inches, by some one of the following Numbers, according to the Cause.</td>
<td>Rule.—Multiply the Square Root of the Cube of the Depth in Inches, by some One of the following Numbers, according to the Cause.</td>
</tr>
<tr>
<td>For a small aperture in one side of a large reservoir, the bottom and sides of which do not correspond with the aperture, so as to lead the particles of water thereto in a stream; the edges of the aperture against which the water runs is supposed to be sharp and made of thin plate; the aperture not to exceed 18 inches long and nine inches deep</td>
<td>57.246</td>
<td>39754</td>
</tr>
<tr>
<td>For an aperture under the same circumstances as the former, but made in a plank with edges from half to one inch thick</td>
<td>58.0493</td>
<td>49312</td>
</tr>
<tr>
<td>For an aperture of great breadth and more than nine inches deep, such as the weir or dam in a river; it is supposed that the water runs over the edge of a plank or wafer board, one or two inches thick</td>
<td>58.88</td>
<td>40886</td>
</tr>
<tr>
<td>For an aperture of which the bottom is on a level with the bottom of the reservoir, or for a weir which occupies the whole breadth of a river, and where the water flows over the top of a broad stone-wall so flopped as to conduct the water to the paffage</td>
<td>88.92</td>
<td>6174</td>
</tr>
<tr>
<td>For the full discharge according to theory, supposing no losses from friction. Very large and deep weirs will come near to this</td>
<td>92.592</td>
<td>6430</td>
</tr>
</tbody>
</table>

When the aperture occupies nearly or the whole width of the reservoir, there is no level surface of the water above the aperture, because the water is continually running towards the aperture in a stream; such is the case of a weir across a river, or when water spouts out of the open end of a rectangular trough.

It is extremely difficult to measure the exact height of the water above the bottom of the aperture, for the curvature of the surface of the water will begin several feet up the stream before it arrives at the aperture; and there must be something arbitrary in the measurement, because the surface of the water, even where there is no curvature, is not horizontal but sloping, when the water is in motion. In such cases, the depth must be taken beneath the inclined surface of the water, if we suppose the same prolonged until it reaches the aperture, which can easily be done, by stretching a line along the surface of the water so as to correspond therewith, at the part above where the curvature commences.

We must also make some addition to the discharge, on account of the motion which the water possestes before it comes to the aperture; to do this with accuracy, we may measure the regular velocity of the stream, by throwing in floating bodies, and observing the distance they pass through in a given time, taking care that we make this observation at a part of the channel, where the surface is in a regular motion and not in a state of acceleration, because what we want is the velocity of the water at that point where the curvature begins, in consequence of the deflect of the stream through the aperture. Now when the channel is not of an uniform breadth and depth, as in a mill-dam for instance, the velocity of every part of the stream is different, we shall then find difficulty in measuring.
measuring the velocity by floating bodies, and must apply the wheel stream-measure before defribed; this will give the precise velocity of the surface at any given spot, and we should choose that place where the curvature begins. The velocity so obtained we must add to the mean velocity, and find the discharge by multiplying the sum by the area of the aperture.

Example.——Suppose the depth of the bottom of the aperture to be eight inches beneath the line of the surface of the water; that the width of the aperture is four feet, and that the aperture is in a thin plate with sharp edges. Also that the stream is found by the wheel to move with a velocity of thirty feet per minute, at the place where the surface of water begins to deviate from its regular slope, and to assume a curvature.

Then take the numbers 57.246 from the first case in our last table, and multiply it by 2.83, which is the square root of eight (the depth); thus 57.246 \times 2.83 = 162 feet per minute, for the mean velocity of the water; to this add 30 feet for the previous motion = 192 feet per minute. The area of the aperture is 8 inches, or .66 feet \times 4 feet = 2.66 square feet. Multiply 192 feet velocity by 2.66, and we have 510.72 cubic feet per minute, for the quantity discharged.

Water-Gauge for measuring the Quantity of Water afforded by any Spring or Brook.——The most accurate and convenient method for this purpose, is to construct a temporary bank or dam to intercept the stream, and pen it up into a pond, then in the bank or dam fix a board with an aperture in it for the water to flow through. By measuring the width and depth of the aperture as before explained, the quantity can be calculated by the rules already given.

This is what Mr. Smeaton called the water-gauge, and is of most important use, to ascertain the quantity of water which can be procured to supply a canal, or for a town, or a mill, or any other purpose: it is the necessary prelude for undertaking any work, and all persons employed in such pursuits, should understand the manner of fixing up a gauge, and making the necessary observations.

The dam must be of such a height as to pen up the water into a tolerable large pond compared with the aperture, so that the surface of water shall have no sensible inclination or run towards the aperture; and to avoid this, the larger the pond is the better. The water must have so much head from the aperture, as to flow away in a clear stream perfectly free from all obstruction of the water below; but it should not point out so as to fall far in the air.

The aperture should be a rectangular notch cut in the edge of a broad plank; it will be best to make the length of the notch some even number of inches, as 6, 8, 12, or 24, and the depth correspondent to the quantity expected to flow through the aperture.

We recommend that the edges of the aperture be cut sharp, or even faced with a chip of metal plate, and then our fifth rule in the last table will apply with great accuracy. The more common practice is, to use a plank of one inch thick, and leave the edges of the aperture of that thickness, only rounding off the sharp angles; in this case, the second theorem in our table must be used; but this is less certain, because the loss of motion from resistance will not bear a constant portion in different depths, for the thickness of the plank is a constant quantity, and therefore bears a different proportion to the quantity discharged, in every case of a different depth.

The accuracy of our rules, when applied to water-gauges, will appear from the following table.

<table>
<thead>
<tr>
<th>Depth, in Inches, from the level Surface to the Bottom of the Notch, Inches</th>
<th>Cubic Feet discharged per Minute, ascertained by Observation</th>
<th>Cubic Feet discharged per Minute by each Inch in Width, as ascertained by Calculation</th>
</tr>
</thead>
<tbody>
<tr>
<td>the Notch being six inches wide</td>
<td>by the Number 7634</td>
<td>by the Number 49754</td>
</tr>
<tr>
<td>1.</td>
<td>7.25</td>
<td>.458</td>
</tr>
<tr>
<td>1.125</td>
<td>3.68</td>
<td>.613</td>
</tr>
<tr>
<td>1.375</td>
<td>4.07</td>
<td>.678</td>
</tr>
<tr>
<td>1.625</td>
<td>5.1</td>
<td>.85</td>
</tr>
<tr>
<td>1.775</td>
<td>5.75</td>
<td>.958</td>
</tr>
<tr>
<td>2.312</td>
<td>8.03</td>
<td>1.438</td>
</tr>
<tr>
<td>3.125</td>
<td>12.9</td>
<td>2.15</td>
</tr>
<tr>
<td>3.2</td>
<td>13.9</td>
<td>2.316</td>
</tr>
<tr>
<td>4.665</td>
<td>24.4</td>
<td>4.066</td>
</tr>
<tr>
<td>5</td>
<td>26.1</td>
<td>4.35</td>
</tr>
<tr>
<td>6.25</td>
<td>28.5</td>
<td>4.75</td>
</tr>
<tr>
<td>6.5</td>
<td>40</td>
<td>6.66</td>
</tr>
</tbody>
</table>

The two last columns of the table are deduced from calculation, and agree so well with the observations as to give every confidence in the rules. The last column is calculated on the supposition that the aperture is made in a thin plate; but the last column but one is according to Dr. Robison's number, and agrees more nearly with the truth. We believe that Mr. Smeaton's experiments were made on an aperture in a board one inch thick; the aperture was six inches wide.

M. Du Buat's four experiments, denoted by * in the table, were in an aperture 18 ½ inches wide, which we have reduced to six inches, in order to compare them with Mr. Smeaton's. In making this comparison, we have not rejected any experiment, as we were obliged to do in the case of discharge through the apertures beneath the surface.

Self-registering Water-Gauge.——When the produce of a spring or stream is required with great accuracy, the depth of the water flowing through the gauge must be taken very frequently during a whole season, and a mean of all the results obtained. This would require the constant attendance of an intelligent person, and would be liable to mistakes; but a small machine may be made to shew the depth by inscription, so that any careful person can keep the account. Thus, at the side of the water-gauge, fix up a wooden or tin cylinder or trunk, which is open at the bottom, so that the water can enter freely. In this trunk, or tube, let a float be placed, having a small light rod attached to the float that will rise up from it, and appear above the top of the trunk; this part must be divided into inches and tenths, and must have some index fixed to the trunk to read the divisions by. This apparatus must be carefully adjusted; in the first instance, by the person who fixes the gauge, so that its divisions will correspond with the depth of water measured very exactly in the way we have directed; then the float will ever after rise and fall with the surface of the water, and will shew the depth without any necessity of referring to the original mode of measurement, unless it be to verify the adjustment. It is obvious that such an apparatus must be fixed so, that it cannot be deranged either by design or accident. The tube
WATER.

In which the float acts should be in the still water some feet above the plank in which the aperture is made, and have a proper box, or cover, which can be locked up, to secure the whole. The float should be a hollow copper ball, or a glass bottle, because wood or cork floats absorb the water, and sink deeper therein; and the rod of wood should be well painted.

A still more perfect water-gauge is obtained by a small machine to keep the register; for this purpose, let an eight-day clock of the ordinary construction be fixed up in a kind of centry-box, or small house, over the gauge; this is to be connected by wheel-work, with a cylindrical barrel, which is to be placed in a perpendicular direction, and made to turn round once in a week by the clock; a sheet of paper is wrapped round the barrel, and fastened upon it in the same manner as paper is fastened on a drawing-board.

The perpendicular stem of the float must have a small pencil attached to it, with a flight spring to cause it to bear against the paper on the circumference of the cylinder, so as to mark upon it: in this way the pencil marks, at a different part of the length of the cylinder whenever the float rises or falls, and the cylinder turning regularly on its axis by means of the clock, causes these risings and fallings to be marked on different parts of the sheet of paper, so that when it is removed from the cylinder it will have a curved line traced upon it, which shews all the increments and decrements of rise and fall, and affords an exact register of the flow of water, which may be reduced to cubic measure, by our rules already given.

A different kind of water-gauge has been proposed by M. De Baader: two large casks or other vessels are to be fixed side by side, in such position, that the stream of water may be poured into either of them by a spout or trough. The spout is so contrived, as to turn the stream into one or other of the vessels at pleasure, with the greatest ease, but the stream cannot run into both at once. In each vessel is a large float which is connected with a perpendicular stem, so that the stem rises or falls with the float, as the vessels fill or empty; also at the bottom of each vessel is a valve, or sluice, to allow the water to run out from it, and the perpendicular stem from the float is provided with means to open this sluice, whenever the vessel is full of water, and the float rises to the top, or to shut the sluice whenever the vessel is empty; and the same action turns the stream of supply from the vessel which is full, into that which is empty. In this way, the two vessels act alternately to receive the water, and measure it, for while the spout runs into one vessel its float rises until the vessel is quite full; the float then turns the spout and stream into the other vessel, which we suppose to be already empty, and at the same moment it will open the valve in the bottom of the full vessel; the water then begins to run out of the full vessel and to fill the other, which becoming full in turn, its float opens the valve in its bottom. In this way the machine continues to measure the water, and is provided with a small counting machine to register the number of reciprocations it has made.

We have now, as far as our limits will allow, given all the most useful and practical rules for measuring flowing water, and shall conclude by observing, that this is one of the most intricate and difficult subjects in hydraulics, and that no engineer can be fully competent to direct the execution of large works without studying the subject much farther than we have been able to enter into it. Many undrained cafes, and combinations of cafes, will continually arise, which cannot be decided by any previous knowledge. As a resource for such occasions, one should be well versed in the theory of the subjacent, so as to modify the rules laid down for simple cafes, and adapt them to his particular cafe, as far as theory can afford him.

If he only pursues the rules laid down by others, without any knowledge of theory, and without entering into the reason and origin of the rules, his experience will not be of much avail, because he will be unable to correct and improve the rules by his own observations, or if he attempts to do so, he may completely spoil them, by making them false in many cases, in order to obtain truth in some one case.

To attain the knowledge to which we allude, the following authors may be consulted:

Julius Frontinus, De Aqueductibus urbis Romae Commentariorum; written about the year 100, in the time of the emperors Nerius and Trajan. This contains all the knowledge of the ancients on this subject. It is printed in Graviti Theorarum Antiquarum Romanorum, vol. iv. 1630 and 1780. A new edition was also published.

Cafilelli, a disciple of Galileo, Della Meura dell' acque correnti, 1628.

Torricelli De Motu Gravium Naturaliter Accelerato, 1643. In this work we find the origin of the proposition, that the velocities of issuing fluids are as the square roots of the depths.

Raphael Fabretius de Aquis et Aqueductibus veteris Romae, 1679.

Marriott, Traite du Mouvements des eaux, 1686. This work contains a great number of experiments on the motion of fluids, and particularly on jets of spouting fluids; but the reasoning is frequently erroneous.

Guggielmini, L' Acqua dell' acque correnti.—Alfo, Della Natura dell' Acqua, Bologna, 1697.

Guggielmini de Fluvius et Cafilelli Aquarum. These contain a theory which has long since been exploded. He first attempted to apply the principles of falling bodies to the motion of waters in open canals and rivers.

Pollenus, De Motu aquæ mixto, Patav. 1697, 1718, 1723.

Parent Mem. Acad. Par. 1700.

Newton's Principia, 1687. This work contains the doctrine, that the velocity of a spouting fluid is equal to that which a heavy body acquires in falling through half the depth of the column; but which is not correct. And in the second edition, 1713, Newton first points out the contracted vein, and the proportion of its area to that of the orifice to be, as \( \frac{1}{702} \) to 1.

Pollenus De Cafilellis per quæ derivantur fluviorum aquæ, Padua, 1718. He states the area of the contracted vein to be \( \frac{1}{751} \) of the area of the orifice, and he discovered, that more water is yielded by a cylindrical pipe than by a simple orifice.

Michelotti, De Separatione Fluidorum in Corpore Animale, 1719.


Raccolta De Autori che Trattano dell' Altezza dell' acqua, 3 tom. 4to. Florence, 1723. This most valuable collection contains the writings of Archimedes, Alibii, Galileo, Cafilelli, Michelini, Borelli, Montanari, Viviani, Caffini, Gug- gielmini, Grandi, Maurelli, Piccard, and Nardeuici; and an account of the numberless works which have been carried on, in the embankment of the river Po in Italy.

M. Couplel, Des Recherches sur le Mouvement des eaux dans les tuyaux de conduit. Memorie de l'Acad. 1732. This is on the motion of water in pipes, and is given by Belidor in his Arch. Hydraulique.

Architecture Hydraulique on l'Art de Conduire d'elevé et de ménager les eaux pour les différens beoins de la vie, in 4 to. 4 to. par M. Belidor, Commissaire Provincial d'Artillerie, Paris, 1739.
WATER.

from Comiston and Swanston, in leaden and iron pipes; but the supply is very inadequate to the size of the city.

When water is to be conveyed in an open canal, like the New River, the manner of letting out and executing the work is so nearly the same as for a navigable canal, that it is unnecessary to say more than we have already given in our article Canal, except the rules for calculating the necessary slope or defcent to produce the required velocity of the water; and the best theorem for this purpose we have already given in the preceding part of the present article.

We shall only add a few particulars of some of the largest modern aqueducts for conveying water.

Aqueducts.—Belidor states, in his Architecture Hydraulique, that one of the finest subterraneous aqueducts in France is that of Arcueil, which conducts the water from many collecting channels in a stone channel. It is situated in the countries of Rungis, Paret, and Coutin. This aqueduct is 14,920 yards in length, and is constructed in free-stone; it extends from the valley d’Arcueil to an elevated water-cistern, or chateau d’eau, which is at the Porte St. Jaques. The channel has an inclination of 6 inches in 400 yards, or 1 in 6400.

On each side of the water-course is a raised foot-path 19 inches wide, upon which a person can walk as far as the village d’Arcueil. The height of the passage from the bottom of the water-trough to the under side of the arch is 62 feet, except in some places where they have been obliged to make them less, in consequence of the high roads beneath which it passes.

Another subterraneous aqueduct of this kind is that of Rocquancourt, which conveys water to Verailles; it is 3623 yards in length, and in all the length has an inclination of only 33 feet, which was the utmost that could be given it. To construct this aqueduct, they were obliged in many places to dig to a depth of 50 yards, which rendered the execution of it very difficult. One hundred and fifty shafts were made in the length of this aqueduct. They were not made at equal distances, but only in such places as would facilitate the conveyance of materials; eighty of them were lined with stone, and the other seventy, which were not required to last longer than during the construction, were only lined with wood, and stopped up afterwards with a dome of masonry, and filled up with earth to the level of the surface.

This aqueduct cost 325,000 livres. From 1675 to 1678 it never yielded more than 6 pouces of water, and some times gave only 5, 4, 3, or even 2 pouces, according as the dry season were of greater or less duration. The pouce de fontainer is a measure of running water used by French engineers, which amounts to about .48 English cubic feet per minute; hence the 6 pouces would be 2.88 cubic feet per minute.

A pond was made in 1685 at the head of this aqueduct, to drain a country called Trou d’Enfer; and since then it has given 10 and 12 pouces, i.e., 4.8 and 5.76 cubic feet per minute.

When water is conducted in an open channel, it frequently becomes necessary to cross deep valleys; in this case, the channel must be supported on arches like a bridge. This was the object of those vast Roman aqueducts, of which we find the remains at Nimes, Arles, Frejus, &c. The greatest modern works of this kind are those constructed in the time of Louis XIV. to conduct water to Verailles and Marly. One of these is the aqueduct of Maintenon, for conveying the river Bure to Verailles; it consists of three courses of arches, raised one above the other, to support the water-course, which is a channel of stone, and on each side of it is a narrow path with a parapet, which renders it safe to walk along the side of the aqueduct when it requires cleaning or repairing.

In the Philosophical Transactions, it is stated that this aqueduct is 2560 fathoms in length, and consists of 242 arches; the span of each is 63 fathoms, and the thickness of each pillar to sustain the arches 4 fathoms. On the side of the valley next to Maintenon, there are thirty-three single arches, afterwards seventy-one double ones, (that is, having one arch upon another,) then forty-fix treble ones; at this part the water-course is generally 216 feet 6 inches high from the ground up to the floor of the water channel; afterwards there are seventy-two double arches, then twenty single ones, which last reach to a mound of earth, which is raised 50 feet high above the ground for a great distance.

The general height from the ground up to the second arcade or row of arches is 16 fathoms; from the second row to the third or upper arcade 14 fathoms; in the upper arcade, the arches are double the number of those they stand upon; above this is 6 fathoms 6 inches more to the floor of the channel, which is at least 7 feet high besides the parapet.

The pillars at the ground are 8 fathoms thick, but with the slopes and shortening, which are made in every story; the top where the channel runs is reduced to 20 feet broad. There is likewise at each pillar a buttress projecting one fathom, and two fathoms wide to strengthen the pillars.

There is another great aqueduct raised on arches in the Plaine de Bue, which conducts water to Verfailles from the Plaine de Scale. This is built with two ranks of arches, and the lower ones are so much wider than the upper, as to allow room for a carriage-way across the valley about half as high up as the water-course. Drawings of these great works are given by Belidor.

It is difficult to determine the exact slope which should be given to a water-course, in order to conduct a given quantity of water; it can only be known by calculation according to the rules we have already given, and which are founded upon experience. Vitruvius recommended a slope of 1 foot in 200 feet in length; but Belidor says this is much more than is necessarily, and that 1 foot in 3600 feet of length is quite sufficient, when the channel is straight without elbows, or sudden angles, or if the bends at such angles are by easy curves, so that the water is not retarded in changing its direction. He remarks, that the canal from the pool of Trappes, made by M. Picard to conduct the water to Verfailles, had 9 inches slope in 1000 fathoms, or 1 foot in 3500 feet. When the water was run into this, it took four hours to run 8526 yards, though it was urged by a pressure of 38.5 inches. Also, that the aqueduct of Rocquencourt before mentioned has only 3 pies fall in all its length, which is 1700 toises, that is, 1 foot in 3450 feet of length. Whence Belidor directs as a general rule to make the fall 1 inch in 100 yards, that is, 1 foot in 3500 feet, provided the bottom of the trough is of smooth stone, and not muddy. This is the least which can be allowed, and more may be given when the relative levels between the two places will admit of a more rapid descent.

On the Conveyance of Water in Pipes.—This is an object of great importance. The ancients conducted water in pipes only down hill; but never carried it up again, not knowing that water would rise to its own level; but we can conduct water to very great distances, and bring it from one mountain to another in pipes, which descend into the intermediate valleys and rise again, provided that the spring or place from which
which the water comes is somewhat higher than the other end where the water is to be delivered. The water would indeed flow itself at the same level at one end of the pipe as at the other, but it would not run out; and in all cases with the same size pipe, the quantity of water given will increase in proportion as the receptacle at the discharge is below the spring at the other end of the pipe. Hence, if there is a great deal of water to be conveyed to a place situated but little lower than the level of the original spring, a very large pipe must be used to convey any given quantity. But the same quantity may be conveyed in a smaller pipe, and consequently at less expense, if the reservoir is much below the original level.

If the distance is great, the length of the pipes will considerably diminish the quantity of water brought through them, in consequence of the friction of the water against the sides of the pipes; this cannot be prevented, and we must make the bore of the pipe larger, in proportion to the length, if the water be in such quantity and for much wanted as to make it worth the expense. The rules for calculating the proper size of pipes we have already given.

Defaguliers mentions an experiment which he made upon a leaden pipe, whose internal diameter was 1 1/2 inches, and found that at 1400 yards distance from the spring of water that supplied it, it did not give a tenth part of the water that it would have given at thirty yards from the spring, though both places were at the same depth below the surface.

All care should be taken in the construction of a conduit-pipe, to avoid obstructions occasioned by lumps of folder hanging in theinside of the pipes, or by roughness at the joints, if the pipes are put together by ferew-joints. All the cocks and plugs in the pipe should have water-ways fully equal to the section of the pipe.

Those who execute water-works are most tempted to fail in this point by making the cocks too small, because large cocks are very expensive.

The engineer should be scrupulously attentive to this, for a single contraction of this kind may occasion the extra expense of many hundred pounds in making a large pipe to be thrown away, because if the pipe will yield no more water than can pass through the small cock, it would have been as well to have laid a small pipe all the length.

It is of the most material consequence that there be no contraction in any part of a conduit, and it is also prudent to avoid all unnecessary enlargements; for when a pipe is full of water moving along it, the velocity in every section must be inversely proportional to the area of the section: hence the velocity is diminished wherever the pipe is enlarged; and it must again be increased where the pipe contracts.

This cannot be done without expending force in the acceleration; and confining part of the impelling power, whether it be that of a column of water, or the force of a machine.

No advantage can be gained by the flow motion which takes place at every enlargement in a pipe; but every contraction, by requiring a restoration of the former velocity, employs a part of the impelling force; this force must be equal to the weight of a column of water whose base is the contracted passage, and whose height is sufficient to produce that velocity with which the water must pass through the contraction.

This point has often been overlooked by engineers of the first eminence; and has, in many instances, impaired the performance of their best works.

Another point, which must be attended to in the conducting of water through pipes is, that the motion of the water should not be by pulsations, but continuous. When the water is to be driven along a pipe by the strokes of a reciprocating engine, it should first be forced into an air-veil, that the elasticity of the confined air may preserve an uniform motion along the whole length of pipe. If the water is suffered to reft at every successive stroke of the piton, the whole mass must again be put in motion through all the length of the pipe. This requires a useless expenditure of power, and to make the water flow with its due velocity. By employing an air-veil and double or treble acting pumps, we remove this imperfection, because it keeps up the motion in the intervals between the strokes of the piton. The compression of the air by the active stroke of the piton must be such as to continue the impulse during the momentary inactivity of the pump.

Pipes are subject to obstructions from the deposit of sand or mud in the lower parts of the pipes, and from the collection of air in the upper parts of their bendings. The velocity of the water should always be very moderate, and then such depositions of heavy matters are unavoidable; care should therefore be taken to have the water freed from all impurities, before it enters the pipe by proper filtration; and to discharge the sediment which is unavoidable, there ought to be cleaning plugs at the lower parts of the bendings, or rather a very little way beyond them. When these are opened, the water will influe with greater velocity, and carry the depositions with it.

It is much more difficult to get rid of the air which choking the pipes, by lodging in their upper parts. This air is sometimes taken in along with the water at the reservoir, when the entry of the pipe is too near the surface; but it is easy to avoid this source of the air, by making the water enter the pipe beneath the surface. For if the entry of the pipe is two feet under the surface of the water at the spring, no air can ever get in, and a float may be placed over the entry, with a lid hanging from it to shut the pipe before the water runs too low.

Air is disengaged from spring-water by the motion of the water in pafling along the pipe. When pipes are supplied by an engine, air is very often drawn in by the pumps. It is also disengaged from its state of chemical union, when the pumps have a suction-pipe of ten or twelve feet, which is very common. In whatever way it is introduced, it collects in all the upper part of bendings, and accumulates till it will choke the passage, so that scarcely any water will be delivered.

To illustrate this, suppose that the water of a spring, or collection of springs, is to be conveyed through a pipe to the place of delivery, at a mile or half a mile distant from the spring; and that the ground, over which the pipe is carried, has many undulations, and ascents and descents, where it passes over small intermediate hills and valleys. We will suppose the place of declivity to be but a little lower than the water at the spring, for example 9 or 10 feet. If the surface of the water in the spring comes down to the entrance-mouth of the pipe, or only near it, much air will run down with the water into the pipe; and wherever the ground rises in the course of the pipe, this air will lodge itself in the upper parts of the bendings of the pipe, and thereby diminish the water-way so as to force the water to pass through a passage of one-fifth or one-sixth, sometimes one-tenth of the proper bore of the pipe, when full.

Sometimes, though no air should get into the mouth at the spring, there will be these lodgments of air from the first running of the water; for when the water first enters into the pipe, if after coming down from the spring it has
to rife again, to pafs the summit of a small hill, it will run over the eminence without carrying all the air before it, as it had done in other parts of the pipe, before it arrived at such eminence. Hence some air is left in the highest part of the bend, but the water which paffes by the air runs forward and fills the pipe again in the defending part, and so goes on in a full bore, till it comes to the next eminence, where it again runs over the highest part of the rising pipe, leaving a space of air at top, which diminishes the water-way. Then filling the pipe full again, it proceeds till its next rising, and there the water-way is again contracted by the air.

To clear the pipe of this air, if the pipe is of lead, the common way, as practised by plumbers, is thus: at every rifing ground the pipe is laid bare at the highest place, and a nail is driven into the upper fide of the pipe, so as to make a hole through the metal. Whilft the nail is flicking in, the lead is hammered all round the nail, with the pen of the hammer, fo as to make a little button or fpout. When the nail is withdrawn, the air will blow out violently, till at last the water will fuccefs the air; and with a broke or two with the face of the hammer the hole can be quite ftopped up.

This is done at every eminence of the pipe, until all the air is difcharged, and the full quantity of water will be delivered at the oppofite end of the pipe. If the mouth of the pipe at the spring never receives any air, by the defcent of the surface of the water, the pipe may give its full quantity for years.

The way to know when the whole water is delivered is to measure it, when the pipe has been fully cleared of air, as above-mentioned; and when by measure, the quantity of water appears to be deficient, the pipe must again be cleared of air or other obftructions.

If the spring is much higher than the place of delivery, the places where the air will accumulate in the pipe will not be julf at the highest part of the pipe, but a little beyond it; becaufe the water running with more velocity and force, drives the lodged air ftill forward down the pipe, and it mufl lodge in the part where the pipe begins to defend again, its own tendency to fuccefs to the top being counter- acted by the motion of the water. In this cafe, the nail-hole mufl be made beyond the gr eater elevation, or else the run of the pipe mufl be ftopped for fome time, fo that the water may ceafe to be in motion, the air will then go back gradually to the highest part of the pipe, where it may be left out.

Suppose that the water, instead of coming from an elevated spring, be forced up its whole way from a place much lower by an engine, and up the conduit, then the places where the air will lodge will be beyond the eminences of the pipes, but nearer to the upper end. In thefe cafes, it will not be fufficient to prick the pipe with a nail, becaufe air will be continually forced in with the water, and will reflit those places in the pipe from which the air had been emptied. The obftructions thus happening often occasion the burfting of the pipe, or it gives too small a quantity of water, and does damage to the engine.

In fuch a cafe, the following contrivance mufl be used: a small leaden pipe, about thirty feet in length, which is called a rider or air-pipe, is laid at the highest part of the main-pipe, and extends along the top thereof. It communi- cates with the main at the top of the eminence, and also at two other places, at fifteen feet on each fide of the emi- nence. This air-pipe has a little branch and cock. Now if the cock is opened when the engine is working, the air will be pufhed forward till it is difcharged by the air-pipe and cock. If the air goes beyond the eminence, the pipe of communication will certainly difcharge it. When water comes out at the cock it mufl be flut, and the main-pipe will then be full of water, but after fome time, the cock being left flut, air will gather again in the eminence of the main-pipe and lodge; but, if the air-cock is again opened, the air will be difcharged.

When water is forced up by an engine into an elevated ciferin, from which it is to run down a main-pipe to the re- serve where it is wanted, this air-cock will also be very neceffary, becaufe the water in the ciferin sometimes covers the entrance-mouth of the defending pipe, and sometimes not. In that cafe, air goes down with the water.

In leaden or iron pipes of conduit, the difcharge of air is absolutely neceffary if there are any rifes in the pipe. In wooden pipes the air often paffes through the wood and efcape; but if the pipes are tight and thoroughly soaked, the air-pipes and cocks are very ufeful. When water runs from a raised ciferin through a diftance of a mile or two, a man perfon fhould turn the air-cocks two or three times a day.

This trouble may in fome cafes be avoided, by carrying the air-pipe perpendicularly upwards, to an equal or greater height than the entrance mouth of the main-pipe. In this cafe, the water will rife up in the air-pipe to near the fame level as the water at the entrance, but cannot run over. Neverthefs, if any air paffes along the main-pipe, when it arrives at the air-pipe, it will rife up therein in bubbles through the water contained in the perpendicularly air-pipe and efcape. By taking advantage of fome tall building, or large tree to support the perpendicularly air-pipe, this ex- pedient may in general be applied.

Defaguiers contrived a valve which fhould open to let out the air, and flut again when the water came. It was an in- verted brafs valve fluttering upwards, and falling down by its own weight, with cork fixed to the under fide of it, to make it rife and flut when the water came. This fucceeded in flirft clearing the pipe of air, but it did not anfwer to keep it clear; becaufe, when the valve had been flut fome time, if air fhould extricate itself from the water, it would be driven air, whose force would be equal to that of the water, and would keep the valve flut as well as the water did befere, although the air at flirft could not flut the valve. The only remedy for this difficulty is to make the valve very small, and make a hollow copper veffel for a float. This will rife with conliderable force to flut the valve, when the water acts upon it; and it will be sufficiently heavy, when the water forfakes it, to pull open the valve.

The fame author afterwards made a better contrivance. It is a small square box of cast-iron, made tight on all fides, except where the air-pipe communicates with the bottom of it, and also where a fpout is fixed on the top to let out the air. This fpout is provided with a cock, situated within the box, and to the plug of the cock a small arm or lever is fixed, having a hollow ball of copper at the extremity of the arm or lever. This ball floats on the surface of the water in the box, and when it rifes opens the cock, or fluts it when it falls. When the air in the pipe accumulates, it paffes along the air-pipe and enters into this box, and as the quantity increases, the surface of the water in the box fubfides, until the float at the end of the lever, opens the cock and allows the air to efcape, and this it will always do before any air can accumulate in the pipe.

It is bleft to place the air-box near to the main-pipe, but it mufl have communication by an air-pipe with the main- pipe, at two or three different places, in order that it may certainly receive all the air which gathers in the great pipe.

On the Discharge of Water by lateral Branch-Pipes from a Main-
Main-Pipe.—It is a common case in water-works, that water is required to be drawn off through a small pipe; from the side of a main-pipe, in which the water is not at rest, but in motion, with a much greater velocity than the flow occasioned by the water which is drawn off through the small pipe. It is often required to know what quantity such small pipe will yield. When water is passing along a pipe, its pressure on the sides of the pipe is diminished in consequence of its velocity; and if a pipe is derived from it, the quantity drawn off must also be less than if the water in the great pipe was motionless. It is therefore of great importance to determine what is the diminution of pressure which arises from the motion along the main-pipe.

It is plain, that if the water suffered no resistance in the main-pipe, its velocity would be that which is due to the height through which it had descended, and it would pass along without exerting any pressure. Also, if the pipe were shut at the end, the pre-ssure within the pipe would be equal to the whole depth of water. Between these limits we shall find what we seek. If the head of water remains the same as when the pipe was stopped, and the end of the tube be constricted, but not stopped entirely, the velocity will be small; and the natural velocity due to the defect being checked, the particles will re-act on what obstructs their motion. This action will be uniformly propagated through the fluid in every direction, and will exert pressure on the sides of the pipe. Now obstructions of any kind, arising from friction or any other cause, will produce a diminution of velocity in the pipe. The resistance, therefore, which we ascribe to friction, produces the same lateral pressure which a contraction of the orifice would do, provided that it would diminish the velocity in the pipe, in an equal degree.

We will first consider the case of an horizontal pipe, in which the whole impelling force is applied at one end of the pipe, either by a pump or by a column in a perpendicular pipe at that end. This force must be transmitted or carried by the water through the whole length of the pipe, wherein part of it will be absorbed in overcoming the obstruction and friction, and the remaining force will produce the velocity with which the water issues at the open end of the pipe. It is evident that every part of the horizontal length of such a pipe must bear a different degree of pre-ssure, when the water is in motion; thus, at the end where it is discharged, there is no pressure exerted on the pipe to arrest it open, because the water can escape freely; but at every other part a force must be exerted, which is sufficient to overcome all the resistance which the water will meet with, in running from such part to the open end, where it is discharged.

In short, whatever part of the column of water in the reservoir, or of the pressure which impels it along the pipe, is not employed in producing velocity, must be employed in acting against some obstruction; and by the reaction of this obstruction, an equal pressure is transmitted to all parts of the pipe. The chief questions will be, in what part of the pipe are these obstructions situated, and at what part is the force applied which is to overcome them; because that part of the pipe which is between the two, must bear the strain of transmitting the force from the place where it is applied, to the place where it is to operate.

In the case where the impelling force is all applied at one end of the pipe, and the only resistance is the friction of the water in running through the horizontal pipe, the pre-ssure to arrest the pipe, will begin at nothing at the open end of the pipe, and regularly increase from that to the other end. Its quantity for 100 feet in length may be ascertained for any given bore of the pipe, and velocity of the water, from Mr. Smeaton's table of friction already given, and may be adapted to all other lengths by a simple rule of proportion.

If in addition to the resistance by friction, which takes place equally in all parts of the length of the pipe, there are any particular causes of obstruc-tion at the extreme end or at any other part, the force necessary to overcome such resistance must be added to that required to overcome the friction, as found by the table; and all this tends to burst open the pipe, or that part which is between the impelling force and the obstruction, which may arise either from a perpendicular column or lift, up which the water is to be forced, or from a contraction.

Example 1.—A steam-engine with a forcing-pump is employed to force water through a pipe, which proceeds horizontally for 1000 feet, and then rises up 60 feet perpendicularly, to a cittern at the top of a tower; the diameter of the pipe is five inches, and the motion of the engine is such, that the water moves with a velocity of 140 feet per minute through the pipe. It is necessary to supply a cittern in a house from the middle of the main-pipe, by a small branch-pipe of one inch bore and 100 feet long; this cittern is 55 feet above the great horizontal-pipe, or five feet beneath the elevated cittern; required the velocity with which the water will flow through the small branch-pipe, when the engine is not at work, and when it is at work.

When the water in the great pipe is motionless, there is the pre-ssure of a column of five feet to force the water through the branch-pipe. Mr. Smeaton's table shews, that for one inch bore and 100 feet long, a pre-ssure of five feet, or sixty inches, will produce a velocity of 180 feet per minute; but when this pipe is running, the water in the great pipe must move also. The area of the pipe of five inches, is twenty-five times as great as the pipe of one inch; therefore, the motion of the water in the great pipe, will be only one twenty-fifth of 180 feet, or 7.2 feet per minute. Find the nearest velocity to this in the table, or ten feet per minute, and under five inches bore, we find .07 inches the height necessary to produce that motion, if the pipe was 100 feet long; but as it is 960 feet, the height required will be .07 × 9.6 = .672 of an inch. This should be deducted from the five feet pressure which urges the water through the small pipe; but so small a quantity is not worth notice: hence we may state the velocity when the engine is not at work at 180 feet per minute, and the discharge from a bore of one inch, will be .98 of a cubic foot per minute.

When the engine is at work, the same pressure will be exerted with the addition of all the pre-ssure necessary to overcome the friction of the water, in running along the great pipe with a velocity of 140 feet per minute. Look for this velocity in the table, and for five inches bore it shews, that a column of 7.6 inches must be allowed for every 100 feet of the pipe. The length of the pipe measured from the place where the branch-pipe proceeds to the cittern at the top of the tower, is 900 feet horizontal, and 60 perpendicular, viz. 960; therefore, multiply 7.6 by 9.6, and we have 73 inches for the height, which must be added to the five feet, and makes 133 inches for the whole column or force, which urges the water to flow through the branch-pipe, when the engine is at work; lastly, by referring to the table in the column of one inch bore, we find that 135 inches will produce a velocity of 270 feet per minute, and the discharge will be 1.47 cubic feet per minute.

The same investigation shews us, that the main-pipe at the place where the branch-pipe proceeds from it, must bear the pre-ssure of a column equal to 66 feet one inch when the engine
engine is at work, although it bears only 60 feet when it is at rest. But if we consider the whole length of 1860 feet, the friction will be equal to a column of eleven feet ten inches, so that the pressure, when the engine is at work, will be near 72 feet, at that end of the pipe which joins to the pump.

*Example 2.*—We will now consider the reverse of this case, that is, to empty the pump and steam-engine, and let the water be propelled through the great pipe, by the water descending from the cistern, with a fall of 60 feet. What will be the pressure which causes the water to flow through the small branch-pipe?

To find this, we must calculate with what velocity the water will flow through the whole length of the great pipe, by the theorem and example we have already given for water in pipes. Having found this, calculating on the whole length of the pipe, we must make another calculation, reckoning only as much length of the pipe as is contained between the cistern of supply, and the place where the branch-pipe joins the main-pipe.

Then take the difference between these two velocities, and it shews what residuum or friction the water must overcome in running along the remainder of the pipe, viz. from the place where the branch-pipe joins to the open end of the pipe, where the water is discharged. Now if a simple orifice was to be made at that part of the great pipe where the branch-pipe joins, the water would flow out with a velocity equal to the difference of the two velocities, making the proper deduction for the friction of the water in passing through the orifice.

But if we wish to know the velocity with which the water will flow through the branch-pipe, we must find the depth of column necessary to produce the velocity equal to the difference of the velocities of which we have before spoken, calculating according to theory, without regard to friction; and then with the depth so found, we can seek in the table of friction in pipes, for the result or flow of water through the small branch-pipe.

The case of a regularly inclined pipe is considerably different, because the impelling force is not all applied at one end of the pipe; but every portion of the pipe having a descent, has also a portion of the impelling power applied to it. When this pipe is of a certain length, the water arrives as its maximum velocity without accelerating; as it proceeds further down the slope; because the accelerating power of the water is in equilibrium with the obstructing friction, that is, the power of descent acquired in a foot or an inch of the slope, is just equal to the residuum in the same distance; consequently, the water exerts no pressure on the pipe to burst it open, any part of the water would continue to slide down the slope with its uniform velocity, even if it was detached from that water which followed or which preceded it, and it derives no impelling power from any column of water. The effect would be just the same, if the pipe were split down the middle and converted into two open troughs.

It is clear, that in this case, no water can be obtained from any lateral branch-pipes, unless they descend from the pipe.

Let us consider the case when the inclination is not a regular slope, but when some parts slope more rapidly than others. In this case, the impelling force is not applied regularly upon every part of the length of the pipe, as in the former instance; the consequence is, that in those parts which have a more rapid slope than the inclination of a line drawn from one end of the pipe to the other, the water will have a tendency to accelerate beyond the regular velocity which is due to the regular slope, and with which it must ultimately flow out of the pipe; and on the other hand, in places where the slope is less rapid than this line, the tendency of the water will be to flow more slowly than the regular velocity. Now the pipe being close and of an equal bore, the water must flow with the same velocity in every part of the length; and although some portions of the contained water tend to run forwards faster than the regular velocity, yet other portions tend to hang back; by means of the pipe, the force is transmitted from one place to another, and these forces become all combined together to produce an uniform velocity.

We shall find, on further consideration of these actions, that some parts may be subjected to a pressure or strain to force or burst it open, and other parts may at the same time be strained in an opposite direction, viz. to crush the metal of the pipe inwards.

Thus at every point where the pipe suddenly changes its slope or rate of inclination, from an easy slope to a very rapid descent, then the water will have a tendency to run down such sloping part of the pipe, and pass away fatter than other water can come down the easy slope; the consequence is, that a suction or aspiration takes place within the pipe, and if a small branch-pipe were applied in such a situation, water may actually be drawn up from a considerable depth. This has been shown by M. Venturi, who calls it the lateral communication of motion between fluids.

This is a certain proof that the bore of the pipe is too small at such places. An attentive consideration of these circumstances, will shew the propriety of making a long pipe with different bores at different places, where the slope is different; for, by judiciously increasing the bore of the pipe where the slope is less, the action may be made uniform throughout. But this cannot be done in cases where the changes of slope are excessive; for instance, when the pipe descends rapidly into a deep valley, and must rise again with a rapid slope in an opposite direction. This is the case with the pipes which supply Edinburgh, and in many situations is unavoidable.

The residuum arising from friction is greater or less according to the velocity of the motion; but whatever is the inclination of a pipe, provided it is long enough, the velocity with which the water runs through it will be adjusted itself, that the sum of all the residua in the whole length of the pipe, will exactly balance the force of all the forces, which the water exerts by its descent. But if the pipe is too short, the forces of descent down the pipe may overbalance all the residua. In this case, the water will tend to accelerate, and the water which has descended near to the bottom of the pipe, will draw after it that water which has just entered the upper part of the slope, instead of the water in the upper part, forcing forwards that water which is beneath it.

Dr. Robison observes that there are some curious circumstances in the mechanism of these motions, which makes a certain length of pipe necessary for bringing it into the equilibrium of motive force, and residuum, which he calls *strain*. A certain portion of the interior surface of the pipe must act in concert in obstructing the motion. We do not completely understand this circumstance, but we can form a pretty distinct conception of its mode of acting. The film of water contiguous to the pipe is withheld by the obstruction of friction, but glides along; the film immediately within this is withheld by the outer film, but glides through it, and thus all the concentric films glide within those around them, similar to the tubes of a telescope, when we draw it out by taking hold of the end of the innermost. Thus the second
The depth of a pipe in diameter must require a greater length, and this is probably in proportion to the number of filaments, or as the square of their diameter.

Du Buat found this supposition agree with his experiments. A pipe of one inch in diameter sustained no change of velocity by gradually shortening it, until it was reduced to six feet, and then it discharged a little more water. But a pipe of two inches in diameter gave a sensible augmentation of velocity, when shortened to twenty-five feet; he therefore says, that the squares of the diameter in inches, multiplied by 72, will express the length in inches necessary for putting the water in any pipe in train.

When pipes are of any considerable length, the waters of a larger pipe will run with a greater velocity than those of a smaller pipe having the same slope. A pipe of two inches diameter will give much more water than four pipes of one inch diameter; it will give as much as five and a half of such pipes, or more, because the squares of the diameters are nearly as the fifth powers of the diameters.

On the requisite Strength for Water-Pipes.—We have shewn that, in certain cases, the water running through a pipe will exert little or no train to burst the pipes. This may be the case in great portions of the length, or even in the whole length; nevertheless we may observe, that at all parts so situated, an open canal would answer all purposes as well as a close pipe. It is not necessary to employ a close pipe in any case, except where it is subjected to a train. We may also observe, that it is prudent in all cases to make the pipe sufficiently strong to withstand the full pressure of the impelling column, when the motion of the water is stopped; because this may happen accidentally, and then the pipe will burst.

In order to judge the strength of a pipe to the strain, we may conceive it as consisting of two half cylinders joined by a beam, parallel to the axis or length of the pipe; the strength of such beams to resist the separation of the two half cylinders will be equal to the ordinary strength of the materials of which the pipe is made. The infide pressure tends to burst the pipe by tearing open these beams, and the force which acts upon any given length of the pipe (as an inch or a foot), is the weight of a column of water whose base is the diameter of the pipe, by the given length (as an inch or a foot), and whose height reaches up to the surface of the water in the reservoir. This follows from the common principles of hydrostatics, and may be calculated by the rules or columns of water already given.

Suppose the pipe to be of lead, one foot in diameter, what will be the force to burst open one inch in length, at the depth of 100 feet under the surface of the reservoir? Water weighs 62½ pounds per cubic foot, the base of the column is 1 foot by 1 inch, or 1/12 of a square foot, and the endemity to burst open an inch long of the pipe is 100 x 62½ x 1/12 = 6250 = 521 pounds nearly.

Therefore, an inch long of each foot is strained by 260½ pounds. A rod of cast lead, one inch square, is pulled funder by 860 pounds. (See Strength of Materials.)

Therefore, if the thicknesses of the beam is \[ \frac{260}{860} \] inches, or one-third of an inch, it will just withstand this strain. But we make it much thicker than this, especially if the pipe leads from an engine which sends the water along it by flarts.

M. Montgolfier states, that a pipe one inch in diameter, and one line in thicknesses, will bear a column of 50 feet, French measure, from which if we divide to know the proper thicknesses for any other diameter, with the same pressure, we shall find it by simple proportion. Thus, if the diameter be 4 inches, the thickness must be four lines; or if the pressure is augmented we proceed in the same manner, by direct proportion, so that for 100 feet it must be two lines thick for one inch diameter, and 8 lines thick for 4 inches diameter.

To make full use of this mode of reckoning, he gives the following table of the pressure which pipes of different substances will sustain.

| Feet high | Copper pipe, 1 inch bore, and 1 line thick, will support a column of water | 400 |
| Brads pipe of good quality, and the former dimensions | 300 |
| Lead pipe, made of sheet lead | 50 |
| Cast-iron pipe, 2 inches bore, and 4 lines thick, will sustain at least | 500 |
| Elm wood 1½ inch diameter, and 2 inches thick | 30 or 40 |

That is, they may safely be made of that size, but will bear sometimes 110 feet pressure.

Leads Pipes.—The plumbers use cast pipes of lead, and also make pipes of sheet lead turned up, and burned or melted together in the longitudinal joints; the different lengths of lead pipe are sometimes burned together with lead at the joints, when they are laid in the field, instead of folding, because this is much cheaper. Lead pipes may be turned up of any size, but are not usually cast of more than four inches bore. Unless the cast pipes are very found, they are not to good as turned-up pipes; hence it is not advisable to use cast pipes of more than 2½ inches bore. There must be great care taken in making the turned-up pipes, that they may be perfectly cylindrical.

Small lead pipes are made by cutting and drawing them through a plate, like wire. See our article Pipes.

The proper thicknesses for lead pipes, according to Desaguilers, is as follows: a pipe, 7 inches diameter, situated from 140 to 80 feet below the reservoir, must be ¾ of an inch thick; that part which is from 80 to 60 feet beneath the reservoir, must be half an inch and an eighth thick; from 60 to 30 feet ½ an inch; and the remainder from 30 feet up to the reservoir ¼ of an inch.

For pipes of four inches diameter, half an inch will do from a depth of 200 feet to 100 feet; from 100 to 40 feet depth ½ of an inch thick; and from 40 feet deep up to the reservoir ¾ of an inch in thicknesses.

Desaguilers describes a method of proving the strength of pipes experimentally, by a small forcing-pump, to inject water into a piece of the pipe at one end, whilst a valve is applied to the other, which valve is loaded with such a weight as will equal the weight of the intended column of water; therefore, if the pipe bears this pressure, it will bear the column of water.

Lead pipes are very improper for water-works, where the water is forced by an engine; for at every stroke or pull from the engine, the water raises the stop-valve of the pump, and
and when the valve shuts again, the water falls with it, and gives a sudden blow against all the sides of the pipe. By the lateral pressure, this force acts in a direction perpendicular to the sides of the pipe, with the weight of a pillar of water whose base is the section of the pipe, at the place of the stroke, and the height is equal to the whole height of the water above that place; and it strikes with the same velocity that the valve falls. Now if the first stroke of this water makes the lead swell outwards but the 100th part of an inch, the lead having no elasticity, will remain in that position, and not shrink back; then suppose the next stroke swells the lead outwards the 100th part of an inch more, the diameter of the pipe will become so much larger and remain so. The next stroke will still make it wider, and so on for many strokes, till at last the lead becomes so thin that it must break. This is inevitable if the force is great enough to begin the enlargement, for after every stroke the force of the water striking will be greater than the preceding, in consequence of the enlargement, and will soon burst the pipe. An iron pipe is best to be used, for even if it were in itself as weak as the lead, it would not be liable to be enlarged, although each stroke should make it yield, but by the elasticity of the metal it would return again to its own dimension after every stroke. The same will happen in pipes of copper or wood, because those substances are elastic.

Wood pipes are made of elm or oak, bored through the middle with a succession of augers, increasing in size until the defined bore is attained. Belidor says a man can bore 39 feet of elm pipe, two inches diameter, in a day, but only 24 feet of oak pipe. The manner of laying and joining pipes is fully explained in our article Pipe.

Care must always be taken that wood pipes are bored in the heart of the wood, and that the heart is of sufficient thickness about the bore of the pipe. Elm pipes of nine inches bore, that are from 80 to 140 feet beneath the surface of the water in the reservoir, must have the heart of elm three inches thick after it is bored; therefore, a tree must be chosen of no less than 18 inches diameter in the smallest part. For a depth from 60 to 80 feet, the heart must be 2\(\frac{1}{2}\) inches thick, which a tree of 17 inches in diameter will afford; for a depth of from 30 to 60 feet, the heart must be two inches thick, and the tree 16 inches in diameter; and for any height under 30 feet, the heart need be but 1\(\frac{1}{2}\) inch thick, for which a tree of 14 inches will suffice.

From these proportions it may be determined what thickness the heart of elm should be for pipes of less bore at the same depths, taking it thinner in proportion to the diameter. Belidor recommends, in laying wooden pipes, to use a composition of mutton fat beaten in a mortar with powder of brick-dust, so as to make a sort of wax. When there are cracks in the wood, small wedges wrapped with tow, and covered with this composition, are to be driven in to stop them.

Earthen Pipes.—M. Belidor states, that the best kinds in France are made at Savigny, near Beauvais; they are in lengths of two feet, which enter three inches into one another, and are made of all diameters, from two to five inches; when the pottery is seven lines thick, they will bear a column of twenty-five feet of water. The joints are made of a composition of pitch, ashes, and brick-dust with mutton fat: this is applied hot, but for larger pipes, a cement of lime is used.

One of the lengths of the pipes for the supply of Edinburgh is made of pottery.

**Iron Pipes.**—The methods of joining and laying iron pipes will be found in our article Pipe; but we shall give a

| Diameter of the Full Diameter of the Flueh. Length of the Thickness of the Weight of the Pipe. |
|------------------|-------------------|-------------------|-------------------|-------------------|
| 2 | 0 | 8 | | | | | | 0 2 10 |
| 2\(\frac{1}{2}\) | 0 | 8\(\frac{1}{2}\) | 6 | | | | | 0 3 4 |
| 3 | 0 | 9 | | | | | | 1 0 10 |
| 3\(\frac{1}{2}\) | 0 | 9\(\frac{1}{2}\) | 6 | | | | | 1 0 27 |
| 4 | 0 | 12 | 6 | | | | | 1 1 18 |
| 5 | 1 | 2 | 6 | | | | | 1 2 18 |
| 7 | 1 | 3 | 8 | | | | | 3 3 20 |
| 10 | 2 | 9 | | | | | | 6 0 10 |
| 11 | 2 | 9 | | | | | | 6 3 4 |
| 12 | 2 | 9 | | | | | | 7 1 22 |
| 13 | 2 | 9 | | | | | | 9 2 17 |
| 14 | 2 | 9 | | | | | | 10 1 22 |

It was afterwards found that, in a long course of practice, it was better to make iron pipes rather thicker; because in moulding there is some uncertainty if the metal is equally thick all round.

**Water, Jets of:** fountains were formerly the ornaments of all gardens and pleasure-grounds; but are now so far out of fashion, that we only find them in the gardens of the greatest palaces.

The most celebrated are those of Versailles and St. Cloud in France, Piazza, near Rome, and Peterhof in Russia. The subject of the latter is the contest of Jupiter with the Titans; it contains a column of nine inches diameter, which spouts sixty feet high.

The fountains of Versailles, which are very numerous and magnificent, are fully described by Belidor.

They consist of four grand pieces, which contain excellent bronze statues, representing some subject of the mythology, besides a great number of jets for the ornament of smaller pieces of sculpture. The basin of Latona consists of many jets, which throw up water obliquely 30 feet high, into three large basins, from which it pours down in cascades. The water-piece of Neptune and Amphitrite consists principally of perpendicular jets, which are very numerous. The basin of Apollo contains the god in his chariot, drawn by four horses; the great jets of this piece rise 57 feet, and the smaller jets 47 feet. The baths of Apollo contain most excellent sculpture, and large sheets of water in cascade. There are also the pyramids of water, mountains of water, alleys of water, theatre of water, &c.

We have no room left for treating this subject, which is of some intricacy, and shall conclude with Mr Marriot's table, which shews the altitude of a referovor necessary to produce a jet of a certain height; and also the quantity necessary to supply jets of a certain bore, measured in Paris feet and Paris pints, 42.36 of which are equal to a cubic foot English.
WATER.

<table>
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<tr>
<th>Altitude of the Jet.</th>
<th>Altitude of the Refervoir.</th>
<th>Quantity of Water discharged in a Minute from an Adjutant Pipe, 400 Lined in Diameter.</th>
<th>Diameter of the Conductant Pipe, fixed to the two preceding Columns.</th>
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See our article JET D’EAU, Vol. XVIII.

WATER, in Gardening, a well known useful article in gardening, as applicable to numerous forts of young plants and trees, feed-beds, &c., especially in the droughty spring and summer seasons, both as grow in the full ground and in pots in the open air, as well as those in greenhouses, flowers, hot-beds, &c.; and also in ornamental designs, in pleasure-grounds, parks, &c., either when formed into regular pieces, circular, oval, or in oblong or ponteauicanals, &c.; likewise when varied in a somewhat natural expanse, in curves and bendings.

In forming designs of this fort, the nature of the supply should be first considered, whether it be by springs in or near the place, by currents or streams passing through, or so nearly adjacent as to admit of being conducted to the place; or by being conducted by some neighbouring river, brook, or lake, &c.; by means of pipes or small cuts, or by being collected issuing from higher grounds, and conducted by proper channels. And another circumstance, equally necessary, is to consider the means by which it may be retained afterwards. In a looey earthen, sandy, or gravelly bottom, it will soon sink away, especially in dry weather; whilst there is a constant current or flow of water running in; but in a naturally strong clayey bottom, of proper thickness, both at the sides and below, it may be retained in some tolerable degree. In most cafes, some art, however, will be necessary in this business. See BASONS, &c.

Where it is easily attainable in any of the above modes, it should not be omitted, on a smaller or larger scale, especially in grounds of any considerable extent; but where intended principally as referrers for watering gardens, they may be of much more moderate dimensions than when designed for ornament, and may be formed either in a circular manner, an oblong canal, pond, or cut, &c.; the whole of these forms being always broken by varying curves of the margins or borders, constantly forming them where the supply of water can be most conveniently procured.

Ornamental plants, or pieces of water in pleasure-grounds, Vol. XXXVIII.
WATER.

manner of conducting it. There are still not a few, who are infected with

--- that strange disease ---

Which gives deformity the power to please:

Collections of ornamental water may, it is said, properly be considered as of two kinds; as those designed to be seen in a general view, and in connection with the adjoining scenery; and those to be seen only when near. The former, subject chiefly of lakes, rivers, ponds, basins, and others of similar kinds; the latter of springs, rills, rivulets, cascades, and others of the same nature. There are scarcely any situations in which waters of the spring, rivulet, and others of the same nature, may not be placed. In nature, rills are usually found deep sunk in hills, as in instances where they run down the sides of hills, or pass through foils of the sandy kind. Where they pass through a fertile valley, or level meadow, they have commonly a regular course; and when they are met with in hollow places, their course is for the most part straight, or approaching to it. The situations of rivers, lakes, and ponds, are almost invariably in the lowest parts of the surface of the land. It is, indeed, impossible that they could be otherwise.

Water, whenever it occurs, is constantly a striking feature in grounds, and in this way has always its peculiar situation: when that situation is changed, every feature is perverted; truth, nature, and harmony, are set at defiance, and the most glaring discord substituted in their place, striking instances of which present themselves in many different ornamental situations.

The general shape of pieces of water must depend upon the nature of the character which is to be created or given them. Whatever may be the magnitude or dimensions of lakes or ponds, they should be of irregular shapes, more or less wooded, and never entirely naked, being constantly distinguished by prominences and mazes; and as often as occasion may serve, further varied by islands managed in a similarity of manner. And the forms and directions of rivers should be given by their sizes, and the nature and kind of country through which they are to pass. Large rivers, in fertile plains, are, for the most part, much less varied in their courses than those of the smaller kind; and both are a great deal less so than those which have their directions through hilly uneven surfaces, or through land of a rocky nature. Large rivers can never be imitated where there does not exist a very considerable stream; as without this, the necessary degree of motion can never be given; but the directions or courses of natural rivers may, it is supposed, be frequently altered, varied, improved, or divided, with the most advantageous effects in the way of ornament; in all which cases the remarks here given will be applicable. Much might be effected in this way at many of the fine ancient seats of this country, and a high degree of grandeur and magnificence of effect be produced.

In regard to the margins or borders of waters, and the accompaniments of them, it is suggested that there are two arguments or reasons, which clearly show that the former, in every piece of water, whatever may be its character, should be broken and diversified. The first of which is, that thereby intricacy, variety, and harmony in form, colour, and disposition, are produced, in the place of monotony or discord; the second is, that this mode prevails in nature. Intricacy, variety, and harmony, are produced in the outline, by making the small parts irregular, considerably so in some places, and less so in others, according to the kind of water; in the ground by producing breaks close to and also at some distance from the water; by leaving the naked or various-coloured earth and gravel intermixed among abruptnesses, smooth slopes, levels, and by every form and disposition of surface; it is further heightened by the introduction of rocks of different shapes, and placed in varied or intricate disposition; and also by roots, decaying trunks, or branches of trees. It is further suggested, that another fruitful source of these beauties is plants, grasses, low growths, shrubs, and trees. Plants and grasses may, it is supposed, be employed both for cloathing such parts of the surface as are smooth, for varying others, and affilling disposition. Shrubs and trees may be used for the last purpose upon a more enlarged scale. Plants, grasses, and low growths, give intricacy and shade to small breaks, and the interlaces among stones, rocks, &c. Shrubs and trees give intricacy to large recesses, either of simple margin, or containing these lesser enrichments, which, shaded by trees, will be heightened in effect. All this, it is supposed, we see accomplished in nature in such a beautiful manner, as far surpasses every fort of description; it may, it is believed, be admired by persons of feeling alone, without much judgment or knowledge of the principles by which it pleases or produces the effect noticed; but this kind of knowledge and judgment is highly useful in directing what to copy from nature, and how to apply it to artificial pieces of water. Without it, persons, it is contended, may argue either for copying the deformities or singularities of nature, or for misapplying them when copied, as has been done by several. There is a difference of character in the margin and accompaniments of a lake, river, and brook, though each is varied or harmonious. Each differs also according to the nature or style of the country, or soil of the land through which they may have to pass, as is evident from a great number of different instances scattered over the country, in which there are particular differences in the banks, adjacent grounds, and accompaniments, that give an interesting variation of character to each individually.

There are some other ornamental appendages which are occasionally placed near to or upon water, such as erections of the bridge, and other kinds. There is no greater ornament to a piece of water of the nature of a river than a bridge, and few objects so generally pleasing, because so universally useful. This notion has been taken advantage of, it is suggested, by improvers, but for the most part in a very injudicious manner. Their bridges are too commonly formal, and unconnected with the scenery, either by their unsuitable magnitude, or by the oblong shapes of their arches, straddling across a shallow sluggish river, as is the case in many well-known situations. They want, it is contended, that beautiful simplicity, connection, and picturesque effect, which may be seen in many high bridges across streams or rivers, and which is produced there by necessity and time. Thus the arches, it is said, are made low when the banks on each side are tame and level, because otherwise carts and carriages would have greater difficulty in ascending them. The architecture is simple, because, in general, the builders were not allowed to incur the expense of ornaments. The plants, ivy-bushes, and trees which grow with them, have sprung up in the course of time, but they may be speedily imitated by art. The broken parapets, piers, or arches, supplied by open raking, or a few pales, are the effects of time, or accident, and in some cases are worth imitating in the scenery of a residence. These circumstances might easily be copied in ornamental scenery, and if judiciously supplied, it is said, will invariably succeed in producing a good effect. Foot-bridges of planks, or rude bales and trunks of trees, suit well, if supposing, with many scenes of the rural kind. They have frequently been attempted, it is asserted, but seldom with complete success, owing to the tafteleasts of those who contrived them.
The other arts of erections which have been usually employed for the purpose of ornamenting water, it is contended, have rarely either picturesque effect, or any use; such, for instance, as those of aquatic temples, statues, river-gods, and other similar absurdities, or what may be called false decorations. Boat-houses, however, of simple contructions, and for the most part all useful arts of erections, may occasionally be introduced with propriety and good effect. The Persian-wheel, the forcing-wheel, the corn-mill, and some others of similar kinds, are had recourse to with excellent effects in different places. "The water-wheel and corn-mill at Warwick-castle, it is said, is perhaps the grandest appendage to that noble building; whether in respect to the train of ideas which it awakens in the mind respecting its former compared with its present use, &c., or its effects in connection with the cascade, for which it forms an excellent apology. And though cascades of this kind be formal of themselves, yet the idea of their utility, it is supposed, compensates, in a considerable degree, for the want of picturesque grandeur; and till the roar meets the ear through woods, or distance, with the same force as in those which are natural."

Mr. London further supposes, that the picturesque improvement of the pieces of water which already exist will be attended to by all those who at present have artificial waters, in imitation of rivers, lakes, ponds, or brooks, and who are in the habit of making improvements of this kind upon their grounds. Such proprietors may, he thinks, be assured that no part can stand in greater need of alterations than such waters; and should they go on with others, except planting, to the neglect of this, they will not certainly merit the approbation of men of taste, as taste always prefers excellence to quantity. "If, it is said, any proprietor should hesitate to alter a piece of water which he has long been accustomed to see without being sensible perhaps of any great deformity, in confluence of habit, if he looks from his windows to a serpentine river, winding among smooth naked turf, with only here and there a few clumps placed at some distance from its margin; if the water presents one uniform glare of light, clear blue, or dull green, and seldom varied by any shadows or reflections but those of clouds and sky, let him, before he decides in favour of the tame river, imagine that in place of this a broad irregular lake, forming bays and recesses, retiring among thick woods, and with its margin in some places abrupt, broken, and varied by fountains, plants, and creepers; in one place smooth, flooding, and covered with grails; and in another clothed with shrubs, trees, and low growths; then let him imagine that he sees these trees, woods, and the different coloured earths and stones of the banks, reflected upon the full surface of the water, which, in some places, was covered with dark shadows from the wood, and in others was bright and clear as the heavens: let him consider how interesting this would appear, even at a distance, and how long he might be employed in tracing with the eye the various recesses, dark places, and reflections; while still much remained indistinct or unseen, and therefore either employed the imagination in completing it according to its own ideas, or awakened curiosity to walk down and examine it minutely, by tracing, as far as could be done without the interruption of thickets and briers, the various windings and intricate margin of the whole. Let him only consider this with the effect of the piece of water already there, which he can see and know as completely by a single glance as if he viewed it an hour; and could examine the two extremities, which are all that could be discovered by walking down to it, as completely in a few minutes as if he were to encompass it a whole day. If the contrast does not strike him, he certainly, it is contended, as far as regards his own taste, is justified in preferring his water as it is; but if otherwise, he ought to commence improvement immediately, not only in gratification of his own sentiments, but also in justice to every attempt to promote and introduce good taste in a country where he is a proprietor, and among a people upon whom he is dependent for his rank and influence. Different styles of improvement may, it is observed, be ornamental, and admired while they are in fashion; but it is only such as this, which are picturesque, or natural, that can stand the test of time."

The first thing to be considered in the alteration of artificial pieces of water, is the character which ought to be adopted; and the next, the execution of that character in the best manner possible, and with the least expense of labour and money. The former has been already fully noticed, and the latter will be particularly considered below. In many cases, however, the alterations required are so very simple, as to stand in need of little, either in the designs or the practical parts, as has happened in altering the waters of different fine country-lets.

In short, the management of natural pieces of water, where they come within the province of picturesque improvement, mostly consists in rendering them more characteristic, and by the occasional introduction of particular effects. The leading principles in effecting the first of these improvements have been made sufficiently obvious already; and the latter are derived from what takes place in nature; as in the cases of waterfalls, cascades, springs, and dropping banks or rocks, on the margins of large brooks or rivers, all of which may, it is supposed, be imitated in particular instances. Alto, in rills and smaller streams there are down-pools, ponds, and little lakes, which often occur in their courses, that are highly worthy of imitation for their intrinsic beauty, their contract with the narrow rills, and their use in landscape. Besides, it is suggested that a great advantage of such pools, or little lakes, is, that they may be made to appear natural where no other variety of full water could possibly be attempted. And that, in nature, they are found on the sides of declivities, where they are, for the most part, covered by wood, and seen only on a near view. In level places or situations, or such surfaces as are not strikingly inclined, they are or may be opened in some parts, for the purpose of being seen from distant places in the grounds, as is admirably done in some cases.

Another sort of occasional appearance or effect is islands, and they are particularly deserving of imitation, especially in lakes and ponds; nay, even in large rivers or brooks they have often a good effect. In large rivers they are mostly long and narrow; and in brooks frequently so large as to be wholly out of proportion to the stream, containing much extent of surface; but sometimes they are extremely small, and only contain a single bush, a few bushes, trees, or fountains and plants; each of which cafes may be seen in almost every brook, and they deserve imitation. Islands in ponds, it is supposed, should rather be numerous and near together, than large and distant, and be situated rather approaching the sides than the middle parts: the apparent magnitude of a piece of water may, it is suggested, be greatly heightened from the main point of view, by placing most of the largest islands next the eye, as well as by the mode of planting them. In regard to planting islands in general they should be wooded, but not wholly, and never in such a way as to exclude the appearance of surface, broken ground, rocks, roots, and fountains, which are..."
are more natural to islands than to shores, because it must always be supposed that it has been some of these materials which have either occasioned the accumulation of the island, or prevented it from being washed away afterwards.

Waterfalls and cascades are also occasionally introduced in extensive pleasure-grounds, where there is the advantage of a rivulet, by which they may be formed either in one large fall, or in two or three smaller ones in succession, having large rough stones placed below to break the water, and increase the loud of the torrent in its fall and passage over them, in some degree similar to that peculiar to natural cascades. And fountains, spouting water from images, &c. are sometimes introduced in the centre of small or moderate basins, or other receptacles of water in gardens or grounds, where a supplying head of water is conveniently situated sufficiently high to raise and throw the water from the jet or spout, in a continued full stream, to a considerable height, which falling in the basin, keeps the water of it in motion, prevents stagnation, and is thereby rendered more proper for keeping and breeding fish of the gold and silver kinds, &c. and the spouting and falling of the water have a refreshing effect in the heat of summer. In parterres, shrubbery grounds, and particular kinds of gardens, water is introduced either in the forms of still ponds, dropping fountains, or jets d'eau; but as these are all artificial, no perfect mode can be afforded for imitation. They, however, most of them proceed in some measure on the principle of contrast, which, in every modification of matter, is capable of producing either incongruity, variety, or harmony; consequently, of effecting scenes which shall disgust, please, or highly interest the beholder. Jets d'eau are not at present in such disrepute as they were formerly in this country; but they are, for the most part, left undestroyed, and their proper use less comprehended.

Mr. London, in the above work, remarks, that the epithets waterfalls and cascades denote different characters in ornamental improvements. Where the water falls over a ridge of rock in one or more jets, they are properly denominated waterfalls; and where its fall is broken and interrupted by the irregularity of the ridge, and by other fragments of rocks and stones, they are properly cascades. Both kinds, it is fogged, may be imitated in improved scenery, though hitherto this has seldom been well accomplished, on account either of the restricted practical knowledge of perfons of taste, or the limited or vitiated taste, or deficiency of judgment, in those who have had the necessary practical experience in matters of this kind.

However, waterfalls may either, it is supposed, be imitated directly, by being copied from nature, or indirectly, by the introduction of weirds for the use of water-mills, as already hinted. In imitating nature, the strength or durability of the whole must be equally taken into consideration with that of the beauty. The first depends upon the general form of the whole materials, and the second principally on the foundation; but in a partial way also, on the quality of the materials, and the execution. In every case which is upon a large scale, the foundation ought to be the natural rock, if possible; but on a more moderate or small scale, it may be a secure cavaeufy, fixed by oak piles and crosstanks, the work being performed with great care, and in an exact manner; using such mortar, where necessary, as is capable of refilling water.

It is noticed, that there is one variety of waterfall which may be occasionally seen in nature, and which is highly worthy of imitation, though it is not known to have ever yet been attempted to be introduced. It is that where a small rivulet or rill, at its junction with a river or brook, falls over a rock in one small sheet. It is stated that, "at Matlock Bath, the noise of a small waterfall of this kind forms one of the finest circumstances of the scenery about that place;—borne upon the breeze, its grateful harmony meets the ear in almost every part of the adjacent scenery, in murmurs as varied as their passages through woods and open glades, along the surface of the Dove, under the echoing cliffs of the Tor, or ascending the heights of Abram. This remarkable effect, it is contended, produced by such a small quantity of water, ought to be the greatest encouragement to such as polishes brooks or rivulets, as few cases can occur where it may not be imitated; not indeed with such remarkable success, because the surrounding scenery may not be so varied, but still with such an effect as would amply compensate for the expense, which in every case could be but trifling." Others are suggested, and the best manner of forming them clearly explained by drawn figures.

The nature of waterfalls for the purpose of driving machinery are, it is observed, generally pretty well understood; and that as no dispute in the machinery is requisite, but art is commonly to appear, the principles of strength and durability noticed above are what chiefly demand attention. But it is remarked that it is to be regretted that so few who have rivers take advantage of it, and that so many make cascades equally formal and unnatural, without any real use, and with little beauty, either of character in themselves, or finettes and connection with the scenery about them.

As to cascades, what has been said in respect to waterfalls will in general apply. In those which are upon a small scale, and where there is a plentiful supply of water at all seasons of the year, the same forms may be built with similar care in respect to foundation, solidity, and morter, they being then disguised by rocks of different fizes in a natural manner, in different ways, according to the different circumstances of the places. The same general principles in relation to form will be applicable to all kinds of beds, fift-ponds, &c.; only in these cases the materials are commonly clay or gravel; which last should always be well puddled with clay or fliff loam on the side next the water. In designing waterfalls and cascades, one principal consideration is, it is said, to adapt them properly to the scenery. In some cases, they are quite inadmissible, as in all rivers or brooks without stones or rocks in their beds or margins; and in others where they are few, or where the ground on each side is level, they can never be made of any great magnitude. An attention to nature is, however, sufficient to guide us in this, as well as in every thing else which relates to the subject; a subject which, it is said, is so highly interesting and comprehensive, that it would require a very great space to give a complete elucidation of it in every respect. See Water Falls.

It may be noticed, that in the business of forming ground for water, the earth must be excavated to a proper depth, gradually sloping from the verge to the middle, from three to four or five feet deep; sometimes, however, in low situations, the place is naturally hollowed in some degree, so as not to require a general excavation, or only in particular parts, and some general regulations to the whole, which in extensive designs is a considerable advantage. Where the sides and bottom are of a sandy, gravelly, or flotty nature, or abound in loofe foil, and there is not a constant suppling stream, they must be well secured by the application of a thick coat of well-wrought clay. And where this claying is necessary in the preparatory excavation, a proper allowance should be made
made for the additional coat of clay, to the extent of twelve or fifteen inches in thickens, and of several inches of gravel over it, to preserve the clay from being washed by the motion of the water, and keep it clear, which would otherwise be muddy. But previous to the claying, the loose and uneven parts in the bottom and sides of the cavity should be well rammed, to make the whole firm, even, and smooth; then beginning in the middle space with the clay, and proceeding gradually outward, being careful that no stones, licks, or other matter, get mixed with it, to occasion fissures, or cracks, by which the water may escape, laying it evenly, a small thickness at a time, and spreading it regularly, treading it well with the naked feet; and if dry weather, calting water on it occasionally, ramming it well from time to time with wooden rammers; then gradually applying more clay, in the same manner, to the proper thickens, being careful that every part is so well puddled and rammed, as not to leave the smallest vacancy. Thus continuing the claying in a regular manner each way, from the bottom to the top of the circumference, smoothing the surface evenly, and in dry weather covering it, as the work proceeds, with mats or straw litter, or with the litter of pebbly gravel. When the whole is finished, the water should be let in.

When this has been done, the top or verge must be regulated and levelled, forming it evenly from the edge of the water, in a gradual regular expansion to some extent outward, without any ill flat slope close to the water, distinct from the surrounding superificies; laying the ground with grays turf, especially along the margin, continuing it as far down as the general level of the water. Where the extent is considerable it may be fown with grays-feeds.

In constructing the excavations for a body of water in such situations as are deficient of materials in some of their parts, as too low in some of their boundaries, as either at the ends or sides finking below the general surface of the ground, or the height at which the water is intended to stand; these parts must be strongly banked up to the necessity height in a substantial manner, having a sufficient body of proper materials applied, especially where the part is to form a head at the end of a canal, or other similar piece of water; the whole being inwardly faced with a strong body of well puddled clay.

It is well known by every one, the above writer says, that the expense attending the formation of artificial water by the modes which have hitherto been chiefly practised is enormous, and in some instances scarcely supportable; but by adopting improved methods, such as those which have been suggested, it will in almost every cafe be greatly reduced, and become much cheaper, often to a very remarkable degree. This will be rendered quite evident by considering the different necessary operations in their formation, as they relate to each method of proceeding; such, for instance, as the excavation of the bed for the water, the formation of the head, the spreading of the earth taken out, and the management of the surrounding surface. In regard to the first, the principal reason why it becomes so expensive is, that a river is commonly imitated instead of a lake, which, on account of the natural slope of all grounds, requires not merely larger heads, but a far greater number of them. By in a great measure imitating lakes, one head is, for the most part, all that is required; and this also, many times, of a far smaller dimension than those in the cafes of rivers. This alone often makes a very material difference in the cost.

In what relates to the spreading of the excavated earth, and the regulation of the surrounding surface, as in the method hitherto purveyed in landscape gardening, whatever may be the natural character or tendency of the surrounding surface, it is to be reduced, by levelling, to a smooth, even lawn, or pasture, sloping in a gradual manner from the margin of the water. This of course causes a prodigious expenditure of money; and what is still more disagreeable, it is too frequently quite uncertain, and only capable of being calculated after the finishing of the whole work. The quantity of cubical yards to be removed in the work of excavating can be estimated very nearly to a certainty; but the businesses of levelling is intricate, troublesome, and often of great extent; hence the great excess of expense which is frequently incurred beyond the estimate in this respect in pieces of made water. If any one plan ever had the advantage over another, it is contended that certainly picturesque or natural pieces of water have the full and complete superiority over those of other kinds in what regards expense. In them, it is maintained, the natural character of the ground is preferred or improved, and consequently no expense of levelling is incurred; the superfuous earth produced in the process of excavating being formed into irregular inequalities, or distributed along the banks in such a manner as to augment or increase their character and picturesque, as is evident in numerous instances.

Under other circumstances, vast expense may often be run into, without much, if any, beauty being produced; when it could have been effected to a great extent by the modes which are here advised without laying out much money. Further information on this very interesting subject may be gained by consulting Mr. London's excellent work.

**Water, Rain, Colling of, for Farm Ufe, in Rural Economy,** the providing it in proper situations for the purpose. This practice was formerly adopted in different parts of the kingdom; in moss towns, and in the yards, ponds for the use of cattle, or still to be met with, which have an artificial appearance. In extensive paiture heavy or about the houses of many old farm-lands, pools, or land districts, pits have evidently been formed by art for the purpose of catching such rain-water as may be brought to them by the ridge-furrows, ditches, or other such means, as well as that of land-springs. The art too has been long practised on the southern chalk-hill parts of the kingdom, and still continues, in a great measure, to prevail; and on those, in some northern districts, it has been more lately established, and spreads itself on the neighbouring heights with vast benefit. It is certainly necessary and useful in all dry high situations. It may probably, in some cafes, also be collected into such pits, from the roofs of the buildings, for such purposes, with much advantage; though it has been much too common to draw it up, at great labour and expense, from deep wells formed in the bowels of the earth.

Lately much more attention has been bellowed on this matter than was formerly the case, in moss places, and in some with the greatest success and benefit. It should never be neglected where the want of it is considerable, as liveick never do well under such circumstances. See Pond, Made Streams, and Watering Live-Stock.

**Water, Sea, Management of Land gained from, in Agriculture,** the bringing ground of this fort into cultivation. It has been observed, that the principal difficulty that can occur in any situation will be to keep off the water of the rivulets or rivers that may come from the surrounding lands, and to carry away and deliver to the sea the surface-water collected from the land gained: the next important consideration is that of clearing this land of surface incumbences. It will often happen, it is said, that the ground
WATER.

to be defended is intersected by a river. This is, it is thought, the most expensive and difficult cafe that can occur; but it is here only necessary to carry the defence along each side of it to the sea; and there, where it intersects the other line of defence, to place a flood-gate, which may prevent the tide from entering, except when it may be necessary to admit vessels or other things, and which shall allow the water of the river to pass into the sea. Small rivulets and springs may either be turned along the margin of the land gained, and be let out at one end of the defence where it joins the land, or be led the most convenient way to one or more of the valleys or flood-gates, which it is necessary to make in all defences for excluding the water within. The water collected on the surface of the land gained, may generally be let off by the above flood-gates or valves; but where the defence is extended into the water, this cannot be the cafe, as the level of the sea will moftly be above that of the land. In this cafe, wind-mills for driving pumps must be placed at proper distances, according as the particular cafe may be.

Perhaps, in general, one small wind-mill driving four pumps, may be sufficient for freeing a thousand acres of ground of water. The expence of such a pump-mill would not, it is said, be above twenty or thirty pounds. By making a small defence-bank, from two to four feet high, some distance within the larger one, all the water collected between that and the original shore would be accumulated; and it might be led in a raised canal in the same level to a flood-gate in the outer defence. This would, it is thought, leave very little water to be drawn up by the pump; and in this way, though twenty thousand acres were gained, one wind-mill only would be necessary. Often, and indeed in molt cafes, in place of a wind-mill, the brooks, rivulets, or springs collected within, might easily, it is said, be made to turn a water-wheel, which would be more permanent and uniform than that turned by the wind. A bafon might also be constructed, so that the ebb and flow of the tide would turn a draining-wheel; and a great many other methods might, it is supposed, be successfully adopted. Thus, in land gained from the sea, there cannot, it is thought, be any difficulty in preferring it from water, from whatever quarter it may come. When the land to be gained is more or less covered with fomes, these should be put in flat-bottomed boats at low water; and when the tide floats them, they should be rowed to the proposed line of bank defence, and be then dropped. This mode of conveyance will generally be found the most economical for all the solid materials which are at a distance. Where the ground is sandy or poor on the surface, and angustaceous earth or rich loam below, it may be trench-ploughed to such a depth, as to turn up the good and bury the bad soil. If the soil be shallow, and very rocky, it may still, it is said, be rendered valuable. The most rocky parts may be covered five or six inches deep with mouldy matters, and the whole be sown with either meadow gras-feeds, to be floated with fresh water, or kept as meadow; or with other proper and suitable gras-seeds, and kept as fall-marth. When mud of a good quality and considerable depth is gained, it may, in some cafes, it is thought, be defirable to summer-fallow it for one or more feasons, after it has been secured from the sea. At other times it may be better to sow it with rape-feed for the first feason, and to summer-fallow it the next, as a preparation for a corn-crop, &c.

It is observed that no fort of land can be gained from the sea but what is of great value for the purpofe of cultivation, and especially as it can for the most part be flooded by fresh water as well as by that of the sea at all times. By flooding, the moft barren land or rock, with only an inch or two of soil upon it, will bear excellent pature. Indeed, much of the land in these situations that is often reckoned barren and useless, is mixed with broken shells, and on being examined will be found to contain three or four parts in ten of calcareous matter. Moft of the large rocks, too, within the salt-water mark are, it is said, in a state of rapid decomposition, and so fragile on the surface, as to be easily penetrated by the roots of gras-plants; more particularly after they have been exposed for some length of time to the action of the atmosphere. The large detached fomes often found within the water-mark are not here meant, as these are supposed to be either buried in the ground, or boiled off as above; but those continued rocks which frequently constitute the bases of the sea-shore for great distances, the surface of which is so completely oxidated, and occasionally decomposed and reduced so as to be called rotten, that they are capable of affording either an excellent manure for certain soils, or are fit and proper for supporting the vegetation of faine plants in their actual condition.

The quantity of land of this fort that is easily capable of being obtained and thus cultivated is very considerable, indeed, perhaps not less than some millions of acres in the whole island. See Waste Land, and Watering Land.

Also Salt-Marshes.

WATER, Gum. See Mucilage.

WATER, Hungary. See Hungary Water.

WATER, Laurel. See Laurel.

WATER, Lime, is common water, in which quicklime has been flaked. See Lime-Water.

Waters, Ophthalmoni, or Eye, are such as are good in diforders of the eye. See Collyrium, Eye, and Ophthalmia.

WATER, Tar. See Tar-Water.

WATER, in Anatomy, &c. is applied to divers liquors, or humours, in the human body.

Such is the aqua phlegmatica, phlegmatic water; which is a feros fluid contained in the pericardium.

WATER, in Geography and Hydrography, is a common, or general name, applied to all liquid transparent bodies, flowing on the earth.

In this fene, water and earth are said to constitute our terraqueous globe.

Some authors have rashly and injuriously taxed the distribution of water and earth in our globe as unartful, and not well proportioned; supposing that the water takes up too much room.

The quantity of water on this fide our globe, Dr. Cheyne fuppects to be daily decreasing; some part thereof, it is said, being continually turned into animal, vegetable, metallic, or mineral substances; which are not easily difolved again into their component parts." Philofoph. Princip. of Relig.

Many modern philofophers are of the fame opinion.

An inundation, or overflowing of the waters, makes a Deluge; which fee.

WATER, among Jewellers, is properly the colour or lufure of diamonds and pearls; thus called, by reafon there were anciently suppos'd to be formed, or concreted of water. The term is fometimes also ufed, though lefs properly, for the colour or hue of other precious fomes.

WATER is also ufed in divers ceremonies, both civil and religious. Such are the baptismal water, holy water, &c.

WATER, Holy, is a water prepared every Sunday in the Romish church, with divers prayers, exorcisms, &c. ufed by the people to fongs themfelves with at their entrance, and going out of church; and pretended to have the virtue of washing away venial fins, driving away devils, preferring from
from thunder, dissipating charms, securing from, or curing diseases, &c.

The use of holy water appears to be of a pretty ancient standing in the church: witness St. Jerome, in his life of St. Hilarian, and Guetler, de Benedict., cap. x. &c. M. Godeau attributes its original to Alexander, a martyr under the emperor Adrian.

Many of the reformed have the use of holy water to have been borrowed from the liturgical water of the ancient Romans; though it might as well be taken from the sprinkling in use among the Jews. See Numbers, xix. 17.

Urban Godfrey Siber, a German, has a dissertation, printed at Leipzig, to which, by proofs brought from church history, that one may give holy water to drink to brutes.

_Bitter Waters of Jealousy._ —In the Levitical law, we find mention made of a water, which served to prove whether or not a woman were an adulteress. The formula was this: the priest, offering her the holy water, denounced, "If thou hast gone aside to another, instead of thy husband, and if thou be defiled, &c. the Lord make thee a curfe and an abomination among thy people, by making thy thigh to rot, and thy belly to swell; and this water shall go into thy bowels, to make thy belly to swell, and thy thigh to rot." And the woman shall say, Amen. These curses the priest shall write in a book, and blot them out with the bitter water. When he hath made her drink the bitter water, it shall come o'er her, that, if she be defiled, the water shall enter into her, and become bitter, and her belly shall swell," &c. If he be not defiled, the shall be free, and conceive seed.

Numbers, chap. v.

_WATER._ Interdiction of Fire and. See Interdiction.

_Water of Flux and Hemorrhagia._ That which is used for keeling or raising them in, in the view of procuring the sure vegetable fibrous matters that they contain. The writer of the "Elements of Agricultural Chemistry" has observed, that this water possesses considerable fertilizing powers. It appears, it is said, to contain a substance analogous to alum, as well as much vegetable extractive matter. It puttifies very readily. And that as a certain degree of fermentation is absolutely necessary for obtaining he matters of the flux and hemp in a proper state; the water to which they have been exposed should on that account be used as a manure as soon as the vegetable fibre is removed from it.

_Water, Black_, a disease in neat cattle and sheep, which is not unfrequently of a ferous nature. It has not, however, been yet properly or fully investigated.

In neat cattle it is said to arise from sudden changes in the state of the weather from heat to great cold, the taking of cold on being turned into low wet pastures in the early pring en, and the want of proper water in land dry brooks. Some lupin too that it may be caused by fresh pastures of particular sorts, and that certain vegetables picked up by the cattle may produce it. It consists of a discharge of a dark black bloody nature from the kidneys, ind symptoms sometimes from other parts of the body. It is most probably produced by inflammation terminating suddenly in a state of great debility and relaxation of the parts, so as to admit the dark grous blood thrown out to pass way in this manner.

In flight cases of this nature the cattle do not seem to be great deal affected by the disease, but where the bloody fluid passed away is considerable, and lasts for some length of time, the animals become reduced to a very low state or condition, and great weakness is the consequence, which if not speedily removed by some proper remedy, the cattle soon sink under the pressure of the complaint.

In the cure, except the disease be taken at its commencement, bleeding will seldom be useful or necessary, but the bowels should be well cleared out by powerful evacuating remedies of the hot kind, and kept properly open by their repetition, so that the cattle do not become in the leafed contilipated, which would be hurtful and dangerous. When the discharge continues, balls composed of alum, rust of iron, and a mixture of opium, given in the proportion of a pint of the first, two drams of the second, and three drams of the last. This may be repeated once or twice in the course of the day where necessary, the bowels being always well kept open.

By some of these means the disease may merely be removed without any great difficulty.

Some think that much benefit often arises from the use of nitre in full doses in this disorder, as well as from the change of pasture, in some instances, as from low to such as are rather high in their situation.

In sheep the disease is characterized by much the same appearances, taking place suddenly, more commonly among those of the hog kind, and such as are apparently strong, while feeding in rank pastures of clover or other luxuriant grass kinds. In these cases, there is sometimes much dark bloody watery fluid met with in the stomachs of the sheep after death. The disease in these animals is mortally rapid in its progress, therefore the sheep in such pastures should be constantly well looked to, in order to discover if any of them be indifposed.

In the prevention of the black water in these animals, some have found great benefit by the use of about half a tea-spoonful of sulphuric or vitriolic acid in mixture with a small spoonful of the compound tincture of cinnamon, when given in a cup of cold water to each sheep in the morning, and cotting or housing them in the night feason.

In other cases, when the disease appeared to be present, much advantage has been said to be produced by giving a strong infusion of oak-bark with aromatics, well acidulated with the sulphuric acid, and to which has been added a little of the tincture of opium. The bowels are to be kept in an open state at the same time.

The immediate removal of the sheep into closer fed and drier pastures, will always be attended with great benefit in this disease, and the supplying them with dry food might perhaps in some cases be of utility.

_Water, White_, a name often given to a dangerous disease in sheep.

_Water in the Head_, a denomination frequently applied to a disease in the head of sheep. See Grip and Sturdy.

_Water Braxy_, among Animals, a disease in sheep, which has been disputed by some; but with the writer of the "Shepherd's Guide" is confident exists, having seen and difsected several cases of it after death; and is affirmed, that it is a species of the common braxy or not, will, it is thought, admit of a doubt, though it is always viewed and considered by the shepherd as such. It is flated in addition also, that in two external appearances it has a resemblance to it. The first of which is, that the animal, when living, seems affected much in the same way, lying frequently down, and loitering behind the reef of the flock, appearing likewise somewhat swelled in the body. And that the next is, that like all others afflicted with the braxy of any kind, it will not bleed.
to any extent on opening a vein. The cutting of a vein in
the tail, fpould, or below the eye, will make other sheep
bleed plentifully; but from these scarcely a drop will issue;
and even on cutting the principal vein in the throat, only a
very small quantity, it is said, proceeds to flow out.

However, in the interior appearances it differs very
widely and materially. On opening the sheep, the whole
entrails are, it is observed, swimming in bloody water, none
of which is within the bowels, but only within the rim
of the belly. The gall-bladder is very small, appearing as
having been mostly spilled previously to the death of
the animal, and the urinary bladder is contracted and shrunk
up to a size scarcely noticeable. The small fibres connecting
it with the other parts are inflamed, and on bringing it near
the nose smells somewhat like the other braxy. The bladder
seems entirely without urine, but on blowing it up it is
always quite found, and never bursts; the guts and flesh
are a little discoloured, and have a smell peculiar to that
disorder. The smaller department of the stomach or reid
has some purple spots on it; and, on being felt with the
finger, these are thicker in the texture than the other parts
of it. They seem, too, to have bled a portion inwardly;
this some suppoisles from the liver.

In an essay inserted in the appendix to the Rev. Mr.
Findlater's Account of the Agriculture of the County of
Peebles in Scotland, it is said to be a diseased that is ana-
logous to the supphesion of urine, which is caused by the
want of sufficient activity and exertion. And that it con-
sists in the bladder being over-distended with urine, which
raises violent inflammation in that organ, and produces an
incapacity to discharge the urine that is accumulated.
The consequence of which is, that the urine regurgitates
over the body; the whole carcass is tainted by fedf gloves; the
bladder becomes gangrenous, bursts, and the animal dies.
That young and vigorous sheep are most liable to this fort
of braxy. And that the immediate cause of the diseafe is
feeding too freely on rich succulent diuretic food, and reff-
ning too long in the morning on the layers, taking place
frequently when the shepherds are more negligent than usual
in removing them.

It is supposfed that the diseafe may be prevented by avoid-
ing too free an yfe of succulent diuretic food, and by
moving the animals from the layers on which they are early
in the morning, making them walk about for some time in
the view of encouraging them to pass their urine and
purl.

In attempting the cure, in cafe the bladder be greatly
dilfed and affected, which may be known by there
being a great fulness in the lower part of the belly, the
urine may be endeavoured to be drawn off by the introduc-
tion of suitable implements of the catheter kind, or by cau-
tiously letting it off by incifion or puncture, where that
cannot be done. In either of these ways, when effected,
great relief will be afforded.

And in the view of allaying or preventing inflammation,
the use of proper purging and evacuating injections should
be had recourse to, such as Glauber, or other fefts of the
fame kind; or even warm milk and water be thrown up.

The firft writer, however, thinks that no remedy for the
diseafe has yet been pointed out that can be fully de-
depend upon. See BRAXY, and STRIKING I1, Blood,
or SICKNESS.

WATER, a diseafe in horses of the aedematous or
partial dropfical kind, which is often very troublesome in its
removal. It has no relation or resemblance, however, to
that of the real farcy, being wholly different in its nature,
causes, and effects, though sometimes ignorantly supposfed

to be of the fame kind. It occurs in horses of all kinds
and descriptions, and at most periods of their existence. It is
a soft watery swelling below the skin, and is caused by what-
ever has a tendancy to weaken and destroy the natural
vigour and strength of the body, whether in a local or general
manner, but more especially in the former, such as low
bad keep, want of sufficient cleaning and dreffing, taking
the animals into cold water in a warm flate, too great ex-
posure to cold rains, and many others. It often, too,
happens after severe colds of the epidemical kind. The
swellings take place in different parts, but particularly in
the legs, having a pitted or dimpled appearance when prefed
by the finger. In some cafes, the difeafe has a more
general dropfical affeét, the water not being confined to
any one part, but fhews ifelf in several, over the whole
body, by fuch swellings. Thèse cafes, for the moft part,
proceed from foul feeding, or the effects of eating too
greedily of rich luxuriant after-grasfs. In the former cafe,
the limbs and the whole body are fometimes feen enormously
swelled, and become very hard, the belly and fheath parts
being very greatly dilfeded.

In the cure of the diseafe, in all the cafes, the great objects
are the removal and discharge of the water, and the preven-
tion of its future formation by every possible means. The
former are to be attempted by the giving of strong diuretic
purgative remedies, and the latter by the yfe of medicines
of the thinflengthening kind, so as to brace up and refcore the
tone of the relaxed foldis of the whole body.

In the firft of the above intentions; the combining of
calomel and squills with jalap and aloes, in the propor-
tions of about one drachm each of the two firft, to two drachms
each of the two laft, for a large horse, may be very useful,
when made into a ball, and given every night, or every
other night for four or five times, and repeated as there
may be occasion; throwing in, in the intervals, bark and
other tonics, in full quantities, to refcore and keep up the
strength of the animals.

Rather strong infusions of the fox-glove with aromatics
may likewife be tried, and oak-bark in powder, with the
fame, be given in large doses at the fame time they are
made use of.

The horses should frequently, too, have good mafhes in
which nitre has been put.

Gibfon, however, advises the horses to be purged once or
twice in ten days, and to have immediately a pint night
and morning of the strong decoction or infusion of black
hellebore, prepared by boiling or infufing it in water, and
then adding to four parts of its two parts of white wine, that
has fiood upon the fame for some length of time in a warm flate;
or a ball compound of nitre, squills, and camphor, in the
quantities of two drachms of the firft, three drachms of the
second, and one drachm of the third, made up with honey,
and given once a day, either alone, or washed down with a
hornful or two of the above infusion.

The horses should be kept warm, and have plenty of dry
food while they are under thefe cures of medicine. See
FARcin.

WATER SICKNESS, a diseafe among sheep of the drop-
fical kind. It is a disorder, or fort of affection, arising in the weak flates
of their constitutions, which is incident to all the varieties
of soil and climate, it is said, in its different forms and de-
gres of violence, from Shetland in the north of Scotland,
to the moft southern parts of this country, wherever sheep
husbandry is carried on. It is observed to occur, in general,
among aged sheep, that are subjected to its attacks in con-
quence of weakens, either of the more general or more
local kind. It moft commonly feizes the animals towards
the
WAT

the end of the harvest-season and winter, and on farms which are mortally deftite of shelter. It is, in fact, said to be the genuine offspring of cold and moisture, and perhaps of every thing that debilitating the vigour of the animals.

The appearances that distinguish it to be prent are swellings in the legs towards night, which disappear in the morning, when the lower jaw often becomes a good deal swelled. The eyes are dull, the urine, when noticed, is high colored, the tongue is dry, and as the diseafe advances, the belly often becomes tence, and water is felt undulating in it, especially on being struck on one side with one hand, while the other is kept steady on the other side. The sheep lose their heart and vivacity, their appetites fail them, they become thin and lean, and at last fall away and die.

In regard to the prevention of the diseafe, a dry well-sheltered sheep-walk is said to be good in that intention; and the neighbourhoods of sea-shores are useful in the same view, as have been found by experience. But if the dissenter should shew itself in a severe manner, in very wet seasons, in winter or spring, night-shelter is found of particular benefit in stopping the increasing state of the malady. The animals, too, should have good, green, sweet, dry hay chopped and given them, at the same time with a little oats or bran in some cafes.

In the cure of thofe which are diseased, a shed or room in a houfe, and a full allowance of the same sorts of dry food, are particularly necessary and useful. Some have tried tapping in the advanced stage of the disorder, but with only a temporary relief. Two drachms of cream of tartar given twice a day, in a little warm thin oatmeal-gruel, have been known to have a remarkably good effect. In the more early stages of the complaint, small quantities of calomel, or quills, would probably remove the diseafe, especially if accompanied with a few horns of a strong decoction of oak-bark two or three times a week. By these means, diseased sheep, when taken early, would perhaps be readily restored.

In the above-named part of Scotland, the diseafe is said to be called by the title of shell-sickness, as well as that which is here given it.

**Water-Calamint**, in Botany, the name used for one for a species of mint. See **Mentha**.

**Water-Crowfoot**, in Agriculture, the name of one of the weed kind, on which cows are said by fome to be very fond of feeding. And in the fifth volume of the Transactions of the Linnean Society, Dr. Pulteney has observed that it is not only relished by fwine, but that they thrive remarkably upon it, requiring little or other food until put up to fatten. The produce of it cannot, however, be great, fo that the ufe of it must be limited.

**Water-Creps**, in Gardening, the common name of a small creeping plant of the herb kind growing in watery situations, such as the fides of rivulets, rills, brooks, or other small trickling streams; and which is much employed as a fallad herb, and for eating with bread and butter, or in other modes in its natural flate, as being highly cooling and agreeably bitter. See **Cress**.

**Water-Dropwort.** See **Drop-Wort**.

**Water-Germander.** See **Germander**.

**Water-Hair-grass.** See **Aira Aquatica**.

**Water-Hemp-Agrimony.** See **Water-Hemp-Agrimony**.

**Water-Leaf.** See **Leaf**.

**Water-Lily.** See **Nymphaea**.

**Water Melon**, the vulgar name of a plant of the melon kind, growing in aquatic situations, and the fruit of which is of a watery infipid nature. See **Cucurbita Citrullus**. Vol. XXXVIII.

WAT

**Water-Parfne.** See **Parnep**.

**Water-Pea.** See **Poa Aquatica**.

**Water-Soldier**, a species of **fragilis**; which see.

**Water-Taff**, in Sheep Husbandry, a term applied to that fort of rank grasses that arifes from an excess of wetnefs in sheep-walks and pastures, and which has a tendency to produce the rot in these animals. It may be caused by too much wetnefs in the lands, either naturally, or by the ufe of water on them. It is this probably that makes water-meadows fo dangerous for sheep at certain periods. See **Taff** and **Water-Meadow**.

**Water-Hen**, in Ornithology. See **Fulica Chloropus**, **Fluvijer**, and **RALLUS Carolinus**.

**Water-Ouzel.** See **Sturnus Cinclus**.

**Water-Rail.** See **Rallus aquaticus**, and **Bengalensis**.

**Water-Wagtail.** See **Wagtail**.

**Water-Dog, in Zoology, a variety of the Canis Familiaris.** See **Dog**.

**Water-Elephant.** See **Hippopotamus**.

**Water-Hog.** See **Capirna**.

**Water-Rat.** See **Mus**.

**Water-Ailse**, in Agriculture, a term applied to the flagrant water contained in moof land, in some places, as in some parts of the county of Lancalfe. It is said to be highly prejudicial to animals, when they drink water that is mixed or impregnated with it. It is bent removed from such land by proper draining, and frequent suitable tillage cultivation.

The bringing fuch waters into a state of improvement consequently discharges it in an effectual manner. See **Moss** and **Waste Land**.

**Water-Bailiff.** See **Bailiff**.

**Water-Barrow, Sewing, in Rural Economy, an improved contrivance of this fort.** See **Quendon Water-Barrow**.

**Water-Bearer, in Acronomy.** See **Aquarius**.

**Water-Bellows**, in Mechanics, a machine used to blow air into a furnace, by the action of a column of water falling through a vertical tube. The orifice where the water enters the tube is fo contrived, that the water shall be mixed with air when it enters the pipe; and this air will be carried along with the stream through the tube, and is collected into a proper receiver, from which it is conveyed to the furnace in a continued blast. Thefe machines are much used on the continent, but have never been introduced in England, because they will not produce by any means a greater current of air as may be raised by the fame fall of water, when employed to work bellows, or other machines, by means of a water-wheel.

M. Reaumur has given a minute description of the water-bellows employed for the iron furnaces, in the provinces of Dauphiné and Pays de Foix, in France, where such machines are called trompct. The water is conducted to the furnace by a trough or passage, having an inclination of one inch in a tofe; the body of the trompct is a vertical tube, about 27 French feet in height, and 16 inches diameter on the outside. It is made of two pieces of fir hollowed out, and bound together by hoops of iron.

The form of the interior of the tube contributes materially to its effect. The mouth or upper orifice, where the conduit-throw pours the water into it, is 13 inches diameter; from it diminishes, in the manner of a conical funnel, till at a depth of three feet from the mouth, it is only four inches diameter, which part is called the throat. Here the opening of the tube enlarges all at once to a size of nine inches, which it continues for all the rest of the height. Immediately beneath the throat, (that is, the upper part of
the tube where it becomes nine inches diameter,) ten vent holes are bored through the sides of the tube; they are cylindrical, and two inches diameter; their direction is inclined, so that they point downwards at about an angle of 45 degrees; they are arranged at equal distances round the tube in two rows, the upper row having six holes, and the lower row four: it is through these holes that the air enters. The tube is supported in a vertical position by a framing, and the lower end is introduced into a strong ton or caff, fix feet deep, and almost as much in diameter, though it is rather smaller at top than at bottom. The tube descends through the head of the caff 18 inches, so that it terminates within 4 1/2 feet of the bottom of the caff; and a kind of table made of a flat round stone, or a plate of caff-iron, is placed horizontally in the centre of the caff, at 18 inches beneath the orifice of the tube, being supported by a crofs of wood, placed upon four legs, from the bottom of the caff. The caff is well closed on all sides, particularly round the tube, where it passes through the head; but there is an air-pipe conducted away from the top of the caff, to convey the air to the furnace; and from the bottom of the caff there is an opening, by which the water can pass away. The opening is regulated by a wooden buttlet, which pens up the water to such a height within the caff, that the opening through which the water issues will be always beneath the surface of the water, so as to prevent the escape of the air by the same passage.

The action of this machine is not so easy to explain as its structure, and it has at various times occupied much of the attention of philosophers. Father Kircher was the first who described the machine in his Mundus Subterraneus; but he did not satisfactorily explain the reason of its action. In the Memoires des Savants Etrangers, Barthes, the father, has given a theory which is very defective; and Dietrich was of opinion that the air was produced by the decomposition of the water.

M. Reaumur explains it thus:—The funnel of the tube is always full of water, which issues rapidly through the throat; but finding immediately a larger place, the stream disperses and scatters into drops, because it is no longer enclosed within a cylindrical surface: it does not, therefore, take any conical figure, but the stream is composed of different small streams, or rather suclesions of drops, which are continually changing their position with respect to each other. Now the intervals between these separate streams or drops are occupied by the air which is within the cavity of the tube; suppoft that between two streams separated by air a third comes to descend, it will push the air before it with all its force, and carry the air down to the caff; and this will be replaced by fresh air, entering at the vent-holes. The irregular arrangement which the streams or drops take, either at their issuing from the throat or in continuing their fall, is such that few drops do not carry some air down before them into the caff; the water falling upon the table within the caff dashes on all sides, and releases the air which rises in the caff, and issues through the air-pipe to the furnace, whilst the water falls to the bottom of the caff, and escapes gently through the flues.

A single trunk of the dimensions just described is found sufficient to blow a forge or foundry; but for a smelting furnace, three are joined together, having a common trough of supply, and the air-pipes from the three casks are joined together. M. Reaumur suppofted that a greater height of the fall would produce more air, because it is longer exposed to those changes of position in the different streams of water; but he suppofted that no adequate advantage would be gained by an increase of the diameter of the tube, because it would be more likely, in falling in a large body, to descend in a closer column.

The machines of the Pays de Foix are somewhat differently contructed: in thefe the water is conveyed into a refervoir, from the bottom of which a square trunk or tube descends to the refervoir or air-chef, which is made very long; and the air-pipe proceeds from an elevated part of it, to prevent the danger of spray or small drops being carried into the furnace. Instead of a throat and the vent-holes, the tube is made to divide into two branches, at the point where it passes through the bottom of the upper refervoir; these branches rise above the surface of the water in the refervoir, fo that it cannot enter into them, but the water is admitted at an opening between these two branches, fo that in effect the tube is divided into three, the centre being an opening for the water to descend, whilst the two outside branches admit the air to mix with the water and go down.

The editor of the Art des Forges suppoftes that the vent-holes are udefles, but that the violent agitation of the water in paffing the throat, and daifing upon the table within the caff, is sufficient to change the water into air. This is the fame hypothefis as that of Dietrich.

These various explanations rendered the subject still more obscure; and in 1704, the Academy of Toulouf invited philofophers to determine the caufe and the nature of the stream of air which is produced in these machines. M. Venturi, provfeffor of philofophy at Modena, gave the real anfwer in an excellent paper on the principle of lateral communication of motion in fluids.

To explain the principle, this philofopher suppoftes a number of equal balls to roll along in a horizontal trough, in contact with each other, with an uniform motion at the rate of four balls in a fecond: suppoft, on arriving at the end of the trough, they fall suddenly to a depth of 16 feet. Now, from the laws of gravity, each ball will perform this defcent in a fecond of time; and as four balls succeed each other in each fecond, it follows that there will always be four balls in the air at the fame time. The relative positions of thefe will be as follows: the uppermoft ball will be one foot from the point where they begin to fall, the facond four feet, the third nine feet, and the fourth sixteen feet. This arises from the acceleration which always takes place in descending bodies.

A conderation of this circumstance will give a proper idea of the diffusion and successive separations of the particles which the accelerating force of gravity produces in fluids, or in bodies which fall in a stream.

The rain-water flows out of gutters by a continual current; but during its fall, it separates into portions in the vertical direction, and strikes the pavement with distinct blows. The water likewise divides, and is scattered in the horizontal direction. The stream which issues out of the gutter may be one inch in diameter, and strikes the pavement in the space of one foot. The air which exists between the vertical and horizontal separations of the water which falls is impelled, and carried downwards. Other air succeeds laterally; and in this manner a current of air or wind is produced round the place struck by the water. M. Ven-
WATER-BELLOWS.

four feet in height: it was a plain cylindrical tube, without any throat or funnel. But he found, when the water accurately filled the section of the orifice, and all the lateral openings of the pipe were closed, the pipe no longer emitted any wind.

According to this writer, the circumstances which favour the most abundant production of wind are as follows:—The separation of the descending balls is more rapid in the upper than in the lower part of the fall. In order, therefore, to obtain the greatest effect from the acceleration of gravity, it is necessary that the water should begin to fall at the orifice of the vertical tube with the least possible velocity, and that the depth of the water in the horizontal trough should be no more than is necessary to fill the section of the vertical tube. The vertical velocity of this section is supposed to be produced by a height or head of water in the trough, of a depth equal to the diameter of the tube.

We do not know by direct experiment the distance to which the lateral communication of motion between water and air can extend itself, but we may with confidence assume that it can take place in a vertical tube, whose section is double that of the original section with which the water flows from the trough into the pipe. Let us then suppose the section of the pipe to be double the section of the water in the trough, and in order that the stream of water may extend and divide itself through the whole double section of the pipe, some bars, or a grate, are placed in the orifice of the vertical tube, to distribute and scatter the water through the whole internal part thereof.

Since the air is required to move in the blowing-pipe with a certain velocity, it must be compressed in the receiver. This compression will be proportioned to the sum of the accelerations which shall have been destroyed in the inferior and closer part of the vertical pipe, that is, the part beneath the vent-holes. Taking this closed part of the pipe \( \frac{1}{2} \) foot, we shall have a pressure sufficient to give the requisite velocity in the air-pipe. The fides of this portion of the pipe, as well as those of the receiver, must be exactly closed in every part, to prevent the escape of the air.

The lateral openings in the upper part of the pipe may be so disposed and multiplied, particularly towards the top, that the air may have free access within the tube.

In some machines of this kind, the constructors seem to have been of opinion, that a great height was required in the water-fall; but Dr. Lewis, who made a great number of experiments upon the subject, shews that an increase in height can never make up for a deficiency in the quantity of water; four or five feet, he thinks, is a sufficient height for the water to fall; and where there is a greater height, it may be rendered useful by joining two or more machines together in such manner, that when the water has once committed its air in the condensing cask or vessel, it shall flow out into a new reservoir, and from thence descend through another funnel and cylinder, and fall from it into a condensing vessel, where the air is extricated and carried off through the air-pipe.

Another kind of water-bells was invented by the ingenious Martin Triewald, of Sweden, and is described in the Philosophical Transactions. The machine consists of two casks or tubs open at bottom, and so loaded, that they will sink into water in the same manner as diving-bells. These being so suspended that they can be alternately lowered down into water and drawn up again, will by proper valves and pipes afford a continual blast of air.

Fig. 15. Plate Water-works, represents these water-bells in profile. A A are two casks, made nearly the same shape as diving-bells, being in the form of a truncated cone, or wider below than at top, where they are furnished with clofe heads B B, but at the lower ends A A are quite open. In the heads B B are valves V, which open inwardly, and are made like the palates of other bellows, with their hinges and the valves themselves covered with hatters' felt. They are caused to flint by cally foot springs till the air from above opens them, which happens only when the bellows receive their motion upwards. The valves are flint by means of the pffure of the air within, when they flink down into the water.

On the same heads two pliable leather tubes R R are fixed, one at the top at each water-bells, which tubes are made and prepared in the same manner as those used in water-engines for extinguishing of fire. These leathern tubes or pipes reach from the bellows to the tubes T T, which carry the wind into the furnace, or any other place, according to pleasure.

These two bellows are suspended from the lever by iron chains K K, which are fastened to two sweeps S S, which means they hang perpendicular from the balance-beam, and at the same distance from the centre of its motion C on the opposite sides. On the top of this balance-beam are fixed two flioping gutters F F, into which the stream of water runs from the gutters G G; and gives motion to the whole work, performing the service as an over-shot or any other water-wheel; but they cost much less, and give as even and regular motion as a pendulum, for as soon as so much water runs into either of the inclined planes of the gutters F F, that the weight of the water exceeds the friction near the centre of motion C, and the weight of that bellows which is flunk down into the water, the gutters immediately descends with an increasing velocity till the balance meets with the resistance of the wooden springs H H; during this time it has raised the opposite water-bells, or that bellows which is fixed under the opposite gutter, the gutter which has been flung being come down to the spring H, delivers all the water it has received, and at the same time the water begins to run into the opposite gutter, which receives its load of water almoft as soon as the former is emptied, so that one of the gutters begins its effect as soon as the other has finished, and this continues alternately as long as the stream of water is supplied. These flioping gutters, being upon the balance-lever, therefore, perform all the effect which a water-wheel does in working the ordinary bellows, and by means of the fame power of defending water, but acting reciprocally on opposite ends of the balance-beam.

These water-bells blow the fire on the same principle, which produce the effect of the ordinary bellows, viz. that the air which enters the bellows, and which they contain when the top is raised, is again compressed or forced into a narrower space when the bellows close; and since air like all other fluids moves to that place where it meets with the least resistance, it must conjuently go through the opening which is left for it, with a velocity proportioned to the force by which the air is compressed, and must blow stronger or weaker in proportion to the velocity with which the top and bottom of the bellows are made to approach each other; the blast also will last a time proportioned to the quantity of air that was drawn into the bellows through the valve or pallet.

The fame operation takes place in the water-bells, for the air which they contain must necessarily be compressed by the water, which rises alternately into the bellows A A, and obliges the air to go through the leathern tubes R R, as being the place where the air meets with the least resistance.

In this machine, the chief part of the weight to be moved
moved is balanced in equilibrio, for the bellows A A may be considered as two nearly equal heavy weights in a pair of scales, which in a great part balance each other. The difference is occasioned by that bellows which sinks down into the water, being so much lighter, as it loses its weight by the quantity of water it displaces, from the bulk of air contained beneath the surface of the water. This difference is compensated by the weight of the water which falls down along the flopping gutter, which acquiring the power of a falling body, increases in the same proportion as the bellows to be raised by it increases in weight; for the bellows which sinks down into the water does not at once lose its weight in the water, but gradually as it descends deeper; and in the same manner, the ascending bellows does not at once become heavier than the other, but the weight gradually increases from the time it is first raised till it is quite raised.

Mr. Hornblower some years ago proposed an hydraulic bellows of the same kind as M. Trewald's, except that, to avoid the flexible tubes of leather R R, he employed a lead pipe to go down to the bottom of the cistern of water in which the bellows defended, and turn up again beneath the bellows, so that the orifice of the pipe was above the surface of the water; it therefore communicated at all times from the interior of the bellows to the furnace. Mr. H., in Nicholson's Journal, mentions a very striking difference between the water-bellows, in which the moving chest was eighteen inches square and moved perpendicularly nine inches, and a common pair of Smith's leather-bellows of thirty inches long.

The leather-bellows threw considerably more air to the fire, and its nozzle, compared with the water-bellows, was as 73 to 60 in diameter, but it did not produce so great an effect in bringing on the heat; and the noise of the water-bellows was so great as to almost drown that of the common one. The only difference in other respects is, that in the hydraulic bellows, the pipe went under ground for about eight feet, and the connecting pipe of the other came down about the same distance from the shop above.

Water-Bomb, a name given by our chemist Godfrey to a machine he invented on the plan of Greyf's discovery, for the extinguishing of accidental fires in houses. He considered first, that the unchangeable size of Greyf's engine was a very great objection, and on this plan contrived a medicated liquor, which was such an enemy to fire, that a very small quantity would extinguish as much as a much larger of common water; and this liquor had the farther advantage, that it might be kept ever so long without corrupting, and by that means the vessels containing it would remain always fit for use; whereas in Greyf's method they must have been rotted by the corrupting and fermenting of the water, after a few years. The author of this invention tried it twice in public with us, and both times with all the success that could be wished; but the structure of the vessel was so much the same with that of Greyf's, that Godfrey cannot be allowed any farther merit as an inventor, than that of contriving the medicated liquor instead of common water. The machine is a wooden vessel, made very firm and strong, that the liquor, when once put in, cannot leak out any where; in the centre of this is an oblong cylindric vessel, which is filled with gunpowder; a tube is brought from this to the head of the barrel; and this being filled with combustible matter, and the inner case with powder, and both made of plate-iron, that no water may get in, the vessel is then filled with the medicated, or antiphlogistic liquor. The top of the tube is then covered, and the thing set by fire.

When there is occasion for it, it is only necessary to uncover the tube, and setting fire to the matter in it, it is conveyed to the vessel containing the powder, and the whole machine being thrown into the place where the fire is, is torn to pieces by the explosion, and the extinguishing liquor scattered every way about, on which the fire is quenched in an instant.

The contriver of these things proposed the making of three kinds of them, the one containing five gallons of the liquor: this was the largest size, and contrived for the largest rooms, and most urgent necessities. The second kind contained three gallons; and the smallest, which was meant for a closet, or other little room, contained only two gallons. Thole of the smaller kind also had sometimes a peculiar difference in their structure, the powder-veffel being placed not in the centre, but at the bottom: the intent of this was to fit them for chimneys, when on fire, as by this means the liquor, not being wanted to be scattered on all sides, was carried more quickly upwards. These were fixed on the end of a long pole, and by this means thrust to a proper height up the chimney; and the tube that communicated the fire was placed downwards.

The manner of using the machines for rooms on fire, is this: the person who has the care of them is to throw them as nearly as may be into the middle of the room, and then to retire to a little distance; as soon as he hears the explosion, he may safely enter the room, and with a cloth, or any thing of that kind, put out any remaining sparks of fire that there may be in particular places. If the room be so large, that one of the machines cannot disperse the liquor to every part of it, two are to be used, one being laid at each end: and if several rooms are on fire at once, as many of the machines are to be used, one being thrown into each room. If a whole house is on fire, the lower rooms are first to be taken care of, and after these the upper, as they ascend.

Our Godfrey had scarce better success than his predecessor Greyf; for while he was making his public experiments, one Povey, collecting some of the fragments of his broken vessels, found out the ingredient used in the medicated liquor, and made and sold the things in the same place where he had proved his right to them. It is probable that the medicated liquor was no other than common water, with a large quantity of sal ammoniac, that felt having this virtue of extinguishing fire in a very remarkable degree. But it is to be greatly wondered at, that while all the world were convinced by experiments of the use of the machine, the author made but little advantage of it, and it is now diluted. Act. Erud. Ann. 1724, p. 183.

The society of arts and manufactures, &c. made trials of balls prepared in Mr. Godfrey's method, by his grandson, in a proper edifice erected for this purpose; and they found, that, after the fire had prevailed for a considerable time, and the flame forced its way through the chimney and windows, it disappeared, and was entirely extinguished by the explosion of two of these balls. See Fire, Extinguishing of.

Water-Borne, in the Sea-Language, denotes the state of a ship, with regard to the water surrounding her bottom, when there is barely a sufficient depth of it to float her off from the ground; particularly when the haw for some time relied thereon.

Water-Camlets. See Camlett.

Water, Cataract, of. See Cataract.

Water-Clock. See Clyspsdra.

Water-Colour, in Painting, are such colours as are only diluted.
diluted and mixed up with gum-water: thus called, in contradiction to oil-colours. See Washing.

The use of water-colours, makes what we call limning; as that of oil-colours does painting, properly so called.

Painters in water-colours have been often afflicted with the disease called colica pictorum, occasioned by the poisonous quality of several of the pigments which they use; and which, by putting the point of their pencils between their lips, whilst they are studying their subject, they incontinently swallow. Dr. Fothergill says, that, when the vomitings are abated, copious discharges by stool are procured, and the functions of the bowels in a degree restored to their usual state by the method pursued in the cure of the colica pictorum; nothing contributes so effectually to restore the use of the limbs, when impaired by these causes, as the liberal and constant use of the tinctura guaiacina volatilis; which may be given in such quantity, as to keep the body gently open; mixed with a little common sugar or honey, and then diluted with any weaker mucilaginous liquor, as thin gruel, or barley-water, or marshmallows-tea. Med. Obs. vol. v. p. 304.

Water-Cisterns, for Rural Purposes, such as are formed for different domestic uses. In high, dry, upland situations, cisterns of this kind are of great utility and importance in many parts of the country. In the account of the agriculture of the North Riding of Yorkshire, it is stated that in the high extremest parts of it, water-cisterns or reservoirs are made by the inhabitants within the ground, which are highly useful: these, it is said, are fed by the rain-water which falls upon the roofs of the buildings, and is conducted from thence by spouts. That in these cisterns a very ample supply of soft water is always ready at hand; and that by their being under ground, and kept close, the water is sweet and suitable for every domestic or other use.

A water-cistern of this sort is stated to be formed in this manner. A cube of the required size being dug in the ground, and the sides made even and perpendicular, the bottom is covered with so much clay, as that, when well beaten, will be four inches thick; a foundation of stone is then laid round the sides; upon the clay, a brick floor is laid in terras, the surface of which should not be lower than the top of the foundation; the sides are then built a single brick thick, and the bricks laid in terras, a foot space being left between the wall and the earth, which is gradually filled with clay in a flat state; and this well beaten as it stiffens; the whole is arched over, leaving a hatchway for a man to go in and clear it out, and an opening or passage into a drain, for the surplus water to run or be taken off, when the cistern is full.

The water is raised for use by means of a pump. In these cases, as keeping all external air out of the cistern contributes, it is laid, much to the sweetness of the water; the pipe by which the cistern is fed should be continued to within a few inches of the bottom, and the surplus water be conveyed off by a pipe rising from near the bottom to the extreme height the water is designed always to be at, when that takes place, and there communicate with the drain: by these precautions, it is said, there will be no more of the surface of the water exposed to the external air, than what is within those pipes and that of the pump.

This method of forming water-cisterns may be found useful, cheap, and convenient, in many places, where such water is necessarily to be preferred pure and sweet.

Cisterns of this sort have sometimes the title of watercellars, and are of great convenience and use for farm-yards. See Water, River, Collecting of, and Watering Live-Stock.

Water-Courts, in Agriculture, are such large ditches or rivulets for taking off the water as are formed, and remain constantly for the purpose in different places, and properly belong to the public.

They should be kept constantly well opened and cleared out, not having too much full given them, so as to destroy the evenness of their bottoms. See Sewer.


Water, Dead, in Sea-Language. See Dead-Water and Ship-Building.

Water-Engine, in Mechanics, denotes either an engine to raise water, or any engine that moves by the force of water.

Water-Falls, in Ornamental Gardening, are those falls of water which are formed and introduced in pleasure or other grounds for the purpose of producing ornamental and picturesque effects, or which naturally exist in such situations. They are of different kinds and forms, being sometimes of the nature of cascades, and at other times contrived for the intention of driving some particular sort of interesting machinery, so as to afford an agreeable and striking picture in the rural scenery of the particular place where they are had recourse to. They are usually constructed, where they do not exist naturally, either by means of large rocky stones thrown rudely together into a sort of ridge form of head, over which the water pauses, formed in the way of weirs, or built in masonry in a careful and exact manner, according as the different nature of the circumstances and situations may require. See Water.

Mr. London, in his useful work on "Country References," has well described and delineated several different modes of forming water-falls. They should, he thinks, be natural, strong, and lasting, from the general form of the whole of the materials, the security and solidity of their foundations, and the quality of the work and materials used in building them.

Water, Foul, in Sea-Language. See Foul.

Water-Fowl. See Fowl.

Water-Furrow, in Agriculture, a deep open furrow drawn by the common or a large double mould-boarded plough made for the purpose, in a proper direction of the field in arable lands, or those in the state of tillage, for the use of conveying and taking off the superabundant hurtful water, and preventing the stagnation of it from injuring the crops. This is especially necessary and proper in the winter season, and often in others. It is therefore essential that, as soon as possible after fowing most sorts of grain, but particularly wheat, when there is any disposition in the field or land to the retention of moisture in too large a proportion, there should be as many water-furrows opened in this way as may be sufficient for carrying off and completely removing the excess of water, and thereby preventing the ground in a properly dry and sound condition for the healthy growth of the crops. It is observed by the writer of the late Calendar of Husbandry, that the making of proper water-furrows is a circumstance of much importance in the culture of wheat, but that it is oftentimes strangely neglected. It is a work, however, that should be well and effectually performed on all lands, except those that are perfectly dry all the winter through. The water-furrows should be formed by the plough, as soon as the field has been finished ploughing, fowing, and harrowing, and then a spat of earth should be dug from out of the bottoms of them, and laid on one side opposite the rise of the land or ridge, and the loose mould in the bottom parts be well trodden and cleansed out, so as to make a perfectly free passage for drawing off the waters; the openings of all the common ridge-furrows being
being likewise well cleaned at the same time, so that the water may have an easy fall out of every one of them into the large water-furrows. The number of these large furrows must constantly depend on the variations of the surface, and some other circumstances of the lands; the only general rule is to make them so many in number, as that no water may be suffered to stand on any part of the land in the wettest weather. In the bottoms or low parts of fields, or other places of them where there is a double slope of the land, it is necessary to form and cut double water-furrows at the distance of about a yard or four feet from each other, in order to take the water from each distinct fling.

The fame writer, too, farther advices, that in all lands fown with clover or other grases among the corn, these forts of furrows should be dug a fitt deep, and the mould raised in that way be carefully thrown out. Many farmers, it is faid, are not attentive enough to this point. They only feour the furrows in fuch cafes. They fhou’d, however, it is thought, confer how long the grases crops are on the ground, which may be two or three winters; consequently it must be very material to fuch crops to lie dry all that length of time, which furring alone will not effect, at least not in a sufficiently perfect manner. Particular attention should also be paid to the spreading of the earth that is dug out of the furrows in fuch cafes, as if the men be not cautioned, they will lay it too thick and injure the crops; it should be chopped and rendered small, and then spread with great care, in order that the feds may rife freely through it.

In the cafe of arable land, these furrows should be often examined during the winter fefon, to fee that they are perfectly open and free; the clofs, lumps, and other fuch matters that may have fallen into them, being cleared out by means of the ipade.

This is a practice which is either much overlooked, or very imperfectly executed, in a great many diftricts of the kingdom. The sides of the furrows in fuch cafes fhould always be made to fland firm, and to have a good flope each way, which prevents their falling in and moulder down to much. The name of water-furrow drain is fometimes given to this fort of furrow. See WATER-Furrow.

WATER-Furrow Full Plough. See the next article.

WATER-Furrow, a term used to signify the operation of opening water-furrows. It is a fort of work modestly executed by the affiftance of a large plough for the purpofe and the ipade, but fometimes by the plough alone. And in fome parts of the county of Efex, particularly in the neighbourhood of Colch ether, they have a method of doing it by means of a machine that is termed a fall-plough: in the lines where this fort of furrowing is to be performed across the hilfettes or ridges, this fort of tool is used there once in fix, feven, or eight years, for the purpofe of lowering or, as they call it, felling the furface. They firft gather four or fix furrows by the plough; then follows this implement across these furrows, in their lowe frefh ploughed flate, taking up the parts of the mould, and dropping them on the crowns or fides of the hilfettes or ridges, and when finifhed, the water-furrows are ploughed and fcolored in the common manner: the invention is faid to have merit, as the water certainly takes a freer course than in the ufual method. In a dry fefon, a large extent of ground can be done in a short time, at little expence, in this way.

Some think this work done in the neated and moft effeclual manner by means of a fhowel; and that an old worn fhowel is the best for the purpofe. See WATER-Furrow.

WATER-Gage, the name of a fimple contrivance for meafuring and alcertaining the depth or quantity of any water in its application to any purpofe, or otherwife. See GAGE.

WATER-Gang, a term applied to a channel or paflage cut through any spot to drain and free a place of water by carrying off a fream from it.

WATER-Gavel, in our Old Writers, a rent paid for fishing in, or other benefits received from, some river.

WATER-Gilding. See GILDING.

WATER-Jampan, a fmall glass instrument, which is a tube of about three-quarters of an inch in diameter, with a ball about ⅛ inch at one end, the other end being hermetically closed; the ball contains water, and the empty space is rendered nearly a vacuum by boiling the fluid previously to felling it. In this instrument the heat of the hand applied to the wetted tube, is sufficient to produce bubbles of vapour, which enter the ball, but speedily collapse. The feries of these condenfations is as quick as 15 or 16 in a fecound. But in the fream-engine the condenfation is prodi-giously more rapid. When a small double fream-engine, on the construétion of Boulton and Watt, having all the parts and gear of the large engines, but its cylinder being only 23 inches diameter, and the length of stroke 62 inches, was fet to work; it gave 600 strokes per minute, or about twice as many as the beats of a common watch. By an easy calculation it may be fhewn, that the fream confined was then much more than 300 cubic inches per fecound; and if the condenfation, instead of being effected in miftles of about a pint at a time, could have been performed by successive collapses of each cubic inch in an open fpace, the pufhes would have produced the tone of the lowe E flat in the treble ftrife. But the number of cubic inches confined in a large fream-engine, e. g., a three feet cylinder with an eight-feet stroke, will be eight or nine times as much as the ufual rate of working. See Nicholfon's Journal, vol. iv. 8vo.

WATER-Level, the level which is formed by the surface of still water, managed in some way or other in a convenient manner for its application in different cafes; and which is perhaps the trueft of any for moft ufed. The term is also applied to and signifies the level ufed in watering land, and performing different other operations in the bufines of agriculture. See LEVEL, SPIRIT-LEVEL, and WATERING Land.

WATER-Levels are also lengths of canal in fome places, that are not connected by locks with other navigations; but at the ends of which the goods are unloaded into team wagons. See CANAL.

WATER-Line and Reel, the frong large line and reel of the garden kind, which is ufed in forming fome part of the works in watering of land.

WATER-Lines, (see SHIP-Building), are the lines of floatation fuppofed to be engraved by the surface of the water on the bottom of a fhip. Of these the moft particular are thofe denominated the light water-line and the load water-line; the former, namely, the light water-line, being that line which fews the depreffion of the fhip's body in the water when light or unladen, or when first launched, called the launching draught of water; and the latter, which exhibits the fame when laden with all her guns and ballaff, or cargo.

WATER-Logged, in Sea Language, denotes the flate of a fhip when, by receiving a great quantity of water into her hold, by leaking, &c. she has become heavy and infactive upon the fea, fo as to yield without resistance to the effort of every wave rufhing over her deck. In this dangerous fuation of a fhip, the crew have no refource, except to free...
her by the pumps, or to abandon her by the boats as soon as possible.

**W A T**

**Water, To Make.** See **MAKE.**

**Water-Machine.** See Machine.

**Water-Mead or Meadows, in Agriculture,** a term applied to that sort of meadow or other inclosed low ground, which is capable of being improved and kept in a constant state of fertility and productive powers, by means of water from some adjoining river, brook, or stream, being thrown and conducted over it in the winter or other proper season. This manner and beneficial practice of forming meadows has prevailed locally for such a very great length of time in different parts of the country, especially in Wilts, Gloucestershire, and Devonshire, that it is extraordinary that it has not been generally adopted and introduced into other districts, where it is equally capable of being had recourse to without great difficulty, and where it may be equally advantageous and proper. This neglect has been ascribed by a late intelligent writer to a deficiency of information among farmers in general, in regard to the nature and management of the bellows, and particularly in what relates to the nature of levels, and the means of adjusting them in different cafes. These circumstances, it is supposed, have confined it to the western districts and parts of the kingdom. Other causes may, however, have operated in this way, as the facilities afforded by the situations of the lands in general, the numerous rivulets and streams always ready at hand for the purpose, and many others of the same nature.

It is necessary that water-meadows should have such a form, either by nature or art, as to make it capable of flowing over their surfaces in a rapid manner, in order to produce and promote the early and quick growth of the grass in a healthy state. It is essentially necessary, too, to their perfect successe and compleatness, that there be at all times a full command of the water, as well as of the means of distributing it to every part of them, and of discharging it in a complete manner, whenever it may become requisite. See Watering Land.

As to the advantages to be derived from meadows of this kind, they are very considerable, not only in the vastly increased quantities of hay which they afford, but also in the point of early spring food for ewes and lambs, as well as in many other respects and particulars. It may be observed, that from the grass of water-meadows being so very forward in the months of March and April, it is in general fed down or pulled in the spring with sheep; and to these farmers who keep them for breeding or fattening, becomes almost invaluable, from the great scarcity of green food at such a period; but that after being flooded in the latter end of the last of these months, they are mostly shut up for hay in the summer.

And the after-grass is eaten off in autumn by next cattle, it being considered as very pernicious and dangerous for sheep to pasture on water-meadows at that season. A remarkable instance of its fatal effects is stated by the writer of the Corrected Account of the Agriculture of the County of Suffolk. Eighty ewes from Weyhill fair were turned into some field adjoining a watered meadow; a score of them broke into the meadow for a night, and were taken out in the morning, and kept till lambing; when they produced twenty-two lambs, all of which lived, but every one of the ewes died rotten before May-day. The remaining sixty made themselves fat, nor could a rotten sheep be discovered amongst them. It is an extraordinary fact, it is said, though not easily accounted for, that the grass of watered meadows should be so nourishing to sheep in the spring, and yet have so destructive an effect on them in the autumn. The fact seems, however, to be well and indisputably established. It may probably depend upon the grass being in a more soft and loose watery state of production in the autumn than what it is in the vigorous growth of the spring. See Treatise and Water-Mead.

By the author of the "Treatise on Watering Meadows," it is advised that no sheep, except those that are just fat, should ever be suffered, even for an hour, in watered meadows, as they will infallibly rot them at any other season than the spring, but especially if made from low, boggy, or swampy ground; but that it is not to, when made from dry healthy land. Others, however, think it dangerous on all, and therefore always to be avoided.

It cannot be doubted but that on farms of this nature, where it is convenient to have three or four meadows that can be watered, they will be found particularly advantageous; as, while neat flock are eating the first, it is said, the second will be growing, the third becoming dry, and the fourth under water; by which an extensive system of feeding and producing of dry fodder may be carried on.

It is noticed by Mr. Smith, in a late essay on these kinds of meadows, that even a small piece of this sort of meadow, which will produce an early crop of spring feed at the very time of the greatest pressure of scarcity, and when the turnips ought to be off the ground, must be much more valuable to a poor arable farm than can easily be imagined by any one who has not witnessed the great utility derived from them, in many parts of Wilts. What, but for the water-meadows, could enable the Wilts farmers, it is asked, to bring to market a much greater number of sheep, and that at an earlier season than can be produced from any other county in the kingdom? The water-meadows have unquestionably a great share in doing this.

They afford, there, it is said, an early supply of grass for the forward or early breed of lambs, on which they begin to feed them about the middle of March, having previously withdrawn the water from them, and laid them perfectly dry. It is observed, that on a good crop of gras of this kind, it has been said, that five hundred couples may be fed on an acre for one day. The practice is to cut vast, such a portion of the ground as is necessary, leaving a few open spaces in the huddled, through which the lambs may feed forward on the fresh gras. The hours they are suffered to feed on this grass, in such cafes, are from about ten o'clock in the morning until live in the afternoon, when they are generally folded on the contiguous barley fallows, or lands in preparation for that crop. This is a practice or form of management, too, which is supposed to have a great advantage, in consequence of its manuring a part of the farm without the dunghill. The manner, however, in such cafes, is drawn from, and at the loss of such meadows.

The writer of the Corrected Report of the Agriculture of the County of Middlesex mentions a remarkable instance of the beneficial and fertilizing effects of water in these meadows, as occurring in the early part of the autumn of 1756, when such gras lands as had not had the advantages of water, as in those cafes, were nearly burnt up. A close of about twenty acres, which had been watered in this way, had, it is said, a most luxuriant after-grass of from six inches to a foot in depth; and a neighbouring inclosure of near forty acres afforded support for three months to forty-seven horses and bullocks, all which throng very well. And another cafe of the same nature is recorded, in which forty acres employed in this way were found equal to the support of five hundred Wilts acres, from the middle of the month of March to the first of May, or about six weeks; and
and that the improvement of the flock in that time was one shilling a week, or three pounds fifteen shillings the acre. In some parts of the same county, five pounds worth of hay might also, it is said, be taken off the first week in May. These facts and statements strongly prove and display the utility of these meadows, wherever they can be properly provided.

In speaking of the management of water-meadows, the author of the essay already noticed remarks, that in those great districts of water-meads, which in Wiltshire are watered by the common content of many different proprietors and occupiers of land, the operation of floating mull begin and end at certain fixed periods, which is necessary for every one to know, and regularly adhere to, not only in order to the production of a crop of grass, but for the pro-creation of those animals that eat the grasses: consequentially, as every farmer knows at what time he shall have grass for his sheep, he so manages his breeding flock, that his lambs may be strong enough at the usual time of feeding to go with the ewes to take their food in the meadows, and return to the fold for lodging.

It is noticed, that the time to commence the feeding on the meadows upon those large streams in this county is generally about the twenty-fifth of March; therefore, if the winter be very mild and favourable for the growth of grass, it sometimes gets to such a height as many farmers, accustomed to the herbage, might think to be much too coarse and luxurious for sheep, and even too high to be fed off with cattle. So great was the luxuriance of the grass in the water-meads of Wiltshire, it is said, some years since, occasioned by the mild growing weather immediately after the commencement of floating, that some farmers laid their meadows dry, and fed them off in November, and the following month; and then, by floating again, obtained a crop of feed in the spring before the usual period. Many who did not adopt this method lamented that their grass was too high, even in the month of February; and it was then not uncommon to see it in the water-meads nine inches high, but laid on the ground, and white at the bottom, before the lambs were strong enough to go into the meadows. Some apprehended, it is said, that the long four grass would be wasted; yet it was astounding with what avidity the sheep devoured it, and even preferred the parts that were the longest, and rendered white at bottom, in consequence of the extreme thickness: this they would, it is observed, gnaw down to the very roots. It was remarked by Mr. Davis, it is said, that the grass that on one Rickwood's mead was such a crop as, at the usual time of cutting it, would have been eliminated at 18 cwt. per acre. Many declared that they never saw the crop of the water-meads so very abundant and early; but on visiting the same meadow, at the particular request of the above-named friend of the writer, on the tenth of March, when it had been in feeding more than three weeks, and skimming the fowler if they ever began to feed it sooner, he replied that he had had the management of the meadows more than thirty years, and never knew it so early but once, when they began feeding it on the eleventh of the first month in the year. The writer walked over the greatest part of this extraordinary piece of ground with some considerable difficulty, it is observed, from the thickness and height of the grasses; and he could discover but one place, to the great credit of the fowler, which was worse than another, and that not two rods square. The man soon saw it noticed, it is said, and before the writer could mention the circumstance, told him he knew what he was looking at, and had contrived to do away even such a trifling defect: so this may be truly said to be, the writer thinks, a spotless meadow. This shews the nice attention and great care bestowed in forming water-meadows in this district; and in some other counties the care bestowed upon the water-meadows is probably not much, if any less. This would seem to be particularly the case in the county of Gloucester, where very great attention is given to the floating of them, to the manner of feeding them down by live-flock, and the cutting them up for the production of hay, as well as in every other part of their management.

They are there, too, equally valuable and important in the quantity and utility of the produce which they afford, as well as the qualities of it, yielding much profit to individuals, and advantage to the whole district.

The utility and benefit of water-meadows are indeed now beginning to be seen everywhere, wherever they are capable of being formed in a convenient and suitable manner.

Water-meadows are in general calculated to afford an early spring food for sheep, or other farts of live-flock, which may be continued in feeding them until towards the beginning of the month of May, when, if designed for the producing of hay, that mull then cease; as, if permitted in even for a single week in that month, the hay would be spoiled by some, be wholly ruined in quality, being rendered soft, wavy, and unsubstantial, as in the case of after-math crops: but then if cut up, and floated for some days, a crop of hay is next produced, which is in readiness for the cutter in about six weeks; and this crop being removed, and the meadows again floated as before, a third or after-math crop is afforded, for being paupered by neat cattle and horses, but never, or in few cases, by sheep, or for being used as cut green food in house-feeding, which, in some cases, is probably the most beneficial application of it; as where one or two more such crops are caured and taken in the same way, at the same season.

The great superiority of the produce from water-meadows is thus rendered very evident, and the uses of it not less valuable or important.

Water-meadows should constantly be well eaten down before they are floated, but especially in the autumn.

It is of great advantage, in many different respects, to have separate water-meadows, which can be alternately in the course of feeding off, floating, and being laid dry, as has been already seen; as by this means, their benefits can never be lost for any length of time. And it is particularly beneficial in providing an uninterrupted succession of after-math pasturage, or of that sort of grass being cut and used green in the fall.

Any thing which is done to the surfaces of water-meadows, in the way of rolling or giving them preflures, should always be done while they are in a quite dry state, about the beginning of the month of March, and never when they are much in a moist condition.

The hay produce of meadows of this sort is mostly proper for all kinds of neat cattle and sheep, but not so suitable for horses, especially those of the working or team kind.

**Water-Measure.** Salt, sea-coal, &c. while aboard vessels in the pool, or river, are measured with the corn bushel heaped up: or else five firked pecks are allowed to the bushel. This is called water-measure; and this exceeds Winchester-measure by about three gallons in the bushel.

**Water-Microscope.** See MICROSCOPE.

**Water-Mill** in Rural Economy, that sort of mill which is turned by the power or force of water applied in some way or other. As mills of this kind often form and oppose great obstructions to different improvements of the farmer,
and especially in the practice of watering land, they should consequently be diminished in number as much as possible in such cases, and those of the tide and wind kinds be substitutted in their places, as might be done with great facility in many instances. See Mill.

**Water, Mother, in Chemistry.** See Crystal.

**Water Ordeal, or Trial,** was of two kinds; by hot, and by cold water. See Ordeal.

**Water-Organ.** See Organ.

**Water, Petrifying.** See Petrifying.

**Water-Pulp.** See Hydrometer, and Areometer.

Dr. Hooke has contrived a water-poife, which may be of good service in examining the purity, &c. of water. It consists of a round glafs ball, like a bolt-head, about three inches in diameter, with a narrow item or neck, one twenty-fourth of an inch in diameter; which being poifed with red lead, fo as to make it but little heavier than pure sweet water, and thus fitted to one end of a fine balance, with a counterpoife at the other; upon the leaff addition of even the very minutest part of salt to a quantity of water, half an inch of the neck will emerje above the water, more than it did before. Phil. Trans. N° 197.

**Water-Proof Cloth and Leather.** It would be very desirable to render the principal articles of clothing impenetrable to water, provided it could be done without injuring the pliability of the cloth.

The most common resource is to line the garment with oil'd silk, such as is used for hat-covers and umbrellas; that is, silk which has been dressed with a varnish of drying linseed oil, fo as to prevent the admission of water. This effectually guards the wearer of such a garment from becoming wet; but it is not perfect, for the outside cloth can imbibe moisture, which will evaporate by the wind, and cause great part of that coldness which renders wet clothes so prejudicial.

What would be desirable is, that we should give to cloth the same property which we find in the fur of several animals; the otter, beaver, and water-rat. This is a repellece of water, which when thrown upon the animal rolls off in pearl drops, without wetting the fur in the leaf; but we observe this only in the living animal, and when in a state of health, for these animals are known to be fick when they are found to be wetted after having dived in the water. This perfection has not yet been attained, but we shall proceed to flate what has been attempted, with a view of water-proof varnish for cloth.

Mr. Albert Angel, in 1781, had a patent for preparing an elasfie varnish for this and various other purposes. His receipt is, linseed oil, or nut oil, one gallon; bee’s-wax (yellow or bleached), one pound; glue or fize, five pounds; verdigris, a quarter of a pound; litharge, a quarter of a pound; spring or rain water, two quarts; to be put into an iron kettle, and melted down till it forms the composition.

Caoutchouc, or elastic gum, called Indian rubber, is a subflance which has engaged the attention of philosophers, ever since it has been known. Its singular elaficity, its flexibility and impenetrability to water, have caused it to be considered as very valuable for this purpose.

It is not possible to effect the liquefaction of caoutchouc, by means of heat; it will melt as well as other refins, but when cooled, it remains liquid and adhesive. Alcohol or spirit of wine, the usual solvents of resinous subflances, do not act upon it, nor is it disolved in water, as gums are; it was then tried to disolve it in drying oils, and it was found that by the aid of heat, the caoutchouc may be disolved, and form an excellent varnish, supple, impervious to air or water; and refilling a long time the action of acids.

With such varnish Messrs. Charles and Roberts covered their air-balloons.

Several effential oils, as those of turpentine and lavender, act upon the caoutchouc, even when cold, and these are of no great price. The disagreeable smell of the oil of turpentine becomes, perhaps in proces of time, les disagreeable than that of the lavender.

The oil of turpentine always leaves a kind of flickines.

The following proces is describ'd in a patent granted to Mr. Henry Johnston of London in 1797, for rendering cloth and other articles water-proof.

The article to be operated upon, must first be cleaned from all greas or dirt by washing it with an alkaline solution, and then stretched in a frame. The water-proof compound, as it is termed, is formed by disolving caoutchouc or Indian rubber in spirit of turpentine, (the smell of which is taken off by adding oil of wormwood, and spirit of wine in equal quantities;) this forms a fort of varnish, which is capable of being spread, or washed over the surface of the leather or cloth, always applying it on the wrong side of the article, or that side which is not to be seen. The varnish is laid on by means of a large piece of Indian rubber, instead of a brush or sponge. To conceal the varnish and make a good internal surface to the cloth or leather, it must be laid over with some subflance, such as silk, wool, or concy, cut very fine, in the same manner as flock paper is made; and being left to dry, in a few days the flock, by its adhesion to the varnish, forms a very good lining, at the same time that it conceals the varnish. These articles were called by the patentee hydrolaines, and were loudly recommended by advertisements, but never came much into use.

**M. Pelletier’s Method of making Varnish of Caoutchouc, or elastic Gum, by disolving it in sulphuric Ether.—**Boil the elastic gum for the space of an hour in common water, by this it becomes soft enough, to be cut into small threads; being thus divided, put it again into boiling water, and keep the veffel on the fire for about another hour; this second boiling penetrates the elastic gum very fenfibly, and deprives it of that hardnes which it posseffes in the firft state.

When the gum is thus divided and softened, put it imme- diately into a matras, or any other clofed veffel, containing rectified sulphuric ether. In the course of a few hours the ether penetrates the elastic gum (which swells very considerably), and at the end of a few days the solution is complete, without the afslance of heat, provided a sufficient quantity of ether is made ufe of.

According to this proces, the solutions are of a white colour and transparent; the heterogeneous and footy particles, which the elastic gum generally contains, fall to the bottom of the veffel in which the solution is made, and have a footy appearance, fo that by merely decanting the solution it may be obtained very clear.

Mr. Parrifh and Mr. Ackermann have likewise had pa- tents for the fame object; the latter succeeded much better than the elastic varnishes.

**Water-proof Leather.—**In the memoirs of the Academy of Sciences at Turin, 1789, is a paper by the chevalier de St. Real, on the manner of rendering leather impermeable to water, without diminishing its strength or its supplenees, and without sensibly augmenting its price. M. St. Real shews that skins may be tanned in such a way as to give this defirable quality to the leather, and in other respects with benefit to the tanner, by reducing all the proceses of the art to the following.

For strong ox or cow leather, which is ufed for making the outer foles of shoes and boots.

1st. Soak the green hides, separate from each other, in

running
running water, a sufficient time to extract all the soluble animal matter or lymph; it will be easy to determine when that is done, by putting a piece of the hide into water, and heating the water gradually; if no scum is formed upon the surface, it is a proof that no lymph remains.

2dly. Place the hides (after they have been washed and cleaned) in a cauldron, similar in constriction to tho' those in which common salt is made; fill the cauldron with water, which is to be heated to 167 degrees Fahrenheit, and no more: after the hides have been one hour exposed to this degree of heat, take them out.

3dly. Stretch them upon the horse, and proceed to take off the hair in the usual manner.

4thly. Put them again into the cauldron (which should be so contrived that it may receive as much water from a cock on one side as is let out from a cock on the other side), and keep up in this cauldron a constant current of water, of the heat of 60 degrees.

5thly. Let the hides remain in this cauldron till the water no longer contains any animal jelly; which may be easily known by evaporating a small quantity of it.

6thly. Take the hides out of the water and place them upon the horse, that the cellular and muscular membrane may be taken off.

7thly. Wash the hides again in running water, then put them again into the cauldron, or one similar to it, which is to be filled with filtered tan-liquor. This liquor is to have the same degree of heat that the water had in the former operation; the skins to remain in it till they are completely tanned, taking care to put fresh tan-liquor in the place of that which shall appear to have lost its energy by the combination of its astringent principle with the hides; this may be readily known by dropping in a few drops of a solution of green vitriol.

The author states, that leather made according to this system would be more free than any other from the animal jelly, which is not combined with the tan, and consequently would be less susceptible of moilure. The fibrous part of the skin being more strongly acted upon by the tan-liquor when heated, would become more firm and more difficult to be penetrated by water; it would be increased in strength and compactness, without losing any part of its softness.

That excellent Swedish leather so superior to all other, of which boots, breeches, and great-coats are made, is capable of resisting the most violent rains. This leather is prepared in Jutland with hot water.

In the common way the tanner contents himself, before he delivers the leather to the shoe-maker, with beating those parts which are soft, or which have a very irregular surface, upon a smooth log of wood with a mallet. The more careful tanners beat all their hides; and this practice is general in England.

Besides the strong folio-leather already mentioned, leather of a different kind is used in a great variety of arts and manufactures. It is made of skins of cows and oxen, but more generally of calves' skins; it serves to make the soles of pumps, or women's shoes; for belts, harnesses, covering trunks, &c. or the inner soles of men's shoes, and the upper-leathers; in short, any kind of work in which the thickest and strongest leather is not required. All this sort of leather is cured, because leather as it comes out of the pits is by no means fit for the various uses for which it is intended; it is rough, of an unequal thickness, and unmanageable. The object of the currier's art is to supple it, and to give it an uniform compactness and density; this object he fulfills by the following operations:

18th. He tread the skins, that is, after having soaked them till they are softened, he kneads them with his feet, to make the water penetrate every part equally.

2dly. He works them with the drum; this is done by applying to the skins a square tool made of hard wood, about a foot long and five inches broad; it is furrowed longitudinally, and convex at the bottom and flat at top; it is fixed to the workman's hand by a leather strap so that it cannot flip. This tool by being worked forcibly along both sides of the skin, first upon the side of the epidermis, and then on that of the flesh, forms the grain of the leather, and gives it suppleness.

3dly. He then works the skin with an iron instrument with a blunt edge; with this he scrapes very strongly those parts which are too thick, those in which there is left any flesh, or any tan, and those in which there are hollows; driving as it were to press the superficies of the thick parts into those which are too thin, and thus to give to every part of the skin an equal thickness and an uniform density.

4thly. He pares the skin with a paring-knife; this paring-knife is circular; the workman cuts away those thick and projecting parts which the operation just described was not able to remove; so that this last operation may be considered as completing the object of the preceding one.

After the four operations above-mentioned, the leather is supple and smooth, and of an equal thickness and density in all its parts: it is now in a state capable of being employed by the workmen who make use of it. But the very operations which give it these valuable properties appear to injure its compactness. The leather by being heated, stretched, and scraped, must necessarily become more spongy, and consequently more permeable to water. To remedy this inconvenience, the currier impregnates it with fat or oil.

To dress leather with fat, it must first be made perfectly dry. The pores of the leather are then dilated, by pitting it over a clear strong fire, and it is rubbed over with a kind of woolen mop dipped in melted fat, pretty hot. The fat thus applied to each side of the leather penetrates into its substance, lodges within its pores, and adhering there fills them up so as to preclude the entrance of any moisture; should the leather be wet when the fat is applied, it will remain upon the surface, and not penetrate into the substance.

The manner of dressing leather with oil is the reverse of this, and is founded upon the property which water possesses of swelling those supple and elastic capillary tubes into which it infuses itself; also that of its not being miscible with oil, and upon that of its evaporating much more speedily than oil.

The currier therefore soaks those skins in water which he means to dress with oil, while they are yet wet, he spreads over them with a wool mop any kind of fish oil. As the water evaporates, the oil takes its place; and consequently the more the skins were swelled with water, the more thoroughly they become impregnated with oil.

M. St. Real found the cow-leather dressed with fat imbibles more water than the calf-skinned dressed with oil; but he attributes this difference to the manner in which the currier applies the fat. He rubs the leather with a kind of mop, dipped into melted fat moderately warm, it seems impossible that, by this manner of applying it, the fat can penetrate into the interior parts of the leather; the air contained in its pores opposes an invincible obstacle to the penetration of it. On the contrary, there is no air in the pores of the wet leather upon which the oil is applied, and the permanent fluidity
WATER-PROOF.

fluidity of the oil itself also facilitates its passage into the leather.

To make the leather imbibe the fat, he proposes three or four days immersion in running water, to drive out the air; then to soak the leather in melted fat, of the temperature of 167 degrees of Fahrenheit, till all the water in the leather is evaporated by the heat; the fat would then penetrate into the interior pores of the leather, and render it impermeable to water.

If leather is compressed, it evidently diminishes the thickness, and increases its compactness; and if it is beaten with an iron hammer upon a very smooth anvil, it produces a permanent contraction of its pores. Leather is in that respect very much like iron, and all other metals which harden by beating; and, consequently, our author suggests that it would be of great advantage to compress the leather before it is used, by passing it between a pair of rollers, such as are used to flatten metal: this would stiffen the leather.

It appears from experiment that the strong sole-leather, by being properly impregnated with fat, and compressed in the rollers, absorbs only one-thirteenth part of water, imbibed by the same leather which has not undergone those operations. The quantity of water which the first absorbs, and which amounts to about one-thirtieth of its weight, is so small, that it does not render it capable of wetting any substance it may come in contact with, nor does the leather appear wet when taken out of the water; it may therefore be considered as almost impermeable to it.

The cow-leather, when impregnated with fat, and compressed, absorbs about one-ninth part of the water absorbed by leather of the same nature which has not undergone those operations. The quantity of water absorbed by the first amounts only to the thirty-fourth part of its own weight.

The calf-skin, when impregnated with fat and compressed, absorbs only one-third part the quantity of water that the same quantity of leather absorbs when it has not undergone those operations; and that quantity is not so much as one-fortieth part of the weight of the leather.

In this manner, without making any alteration in the usual method of tanning, except with respect to the thin sole-leather, it is possible to render leather very nearly impermeable to water, by the known operations of currying, provided to them are added compreッション by rollers, and soaking in fat, as before described. The additional greasing and preffing will not sensibly increase the price of the leather, for it retains only about the sixteenth part of its weight of fat.

The leather which had passed through the rollers was not diminished in its strength; for it supported, without breaking, weights as heavy as were supported by leather of the same kind which had not undergone that operation.

In 1794 Mr. Bellamy of London obtained a patent for a method of rendering leather water-proof, which he thus describes.

Take nut oil, one gallon; poppy-oil, one gallon; and linseed-oil, two gallons; or they may be in other proportions: put them into an iron vessel, and set it over a gentle fire. To every gallon of the mixed oils, put half a pound of umbr, or white coppers, fugar of lead, colochar, or any other proper drier, but observing to use a larger proportion than the above, when the oil is to be prepared for new leather, or a lesser proportion when it is to be prepared for old.

Let the oils remain on the fire, and give it as great a degree of heat as it can bear without burning, or causing it to rise, for six or seven hours; and if it will not dry sufficiently continue the same degree of heat till it does: then take it off the fire, and when it is a little cooled, it is ready to be applied to make water-proof leather.

This is done by a brush being dipped into the prepared matter, and rubbed or brushed into the leather.

When the article is well filled with the prepared oils, lay it on an even board, and scrape off what is superfluous with a thin iron tool; then put it to dry in a warm room, and when sufficiently dry it will be fit for use.

For sole-leather of thick fibubility, let it be gently warmed, and with a brush or pad, made of wool or hair, rub or brush the prepared matter on the leather, till it is thoroughly saturat; then let it dry in a warm place, and it is ready for use.

The proportion of the mixtures of oils, must be varied according to the nature of the oil, and also according to the nature of the leather, for the same kind of oil will not always have the same qualities.

Oils expreffed at different times will frequently have a greater or less propensity to finish; and mult, on that account, have more or less of the poppy or nut oils. If the drying oil finishes reluctantly, there must be added a leffer quantity, or none at all, of the nut or poppy oils, and a small quantity of an essental oil added, till it will finish with ease and beauty. The fame kind of leather will also require a different mode of treatment; for if the leather be new it will abound more with the natural grease of the animal which produced it, and it will require the oil to be so managed as to absorb or neutralize the greasy quality, that it may finish without loading the leather, and making it unpleasant to the wearer. When this is the case, one-fourth part of essental oil of turpentine must be mixed with the above oils when prepared; and vice versa if the leather is old.

Another of Mr. Bellamy's receipts is as follows: to one gallon of the above prepared oils add one pound of gum resin, half a pound of pitch, a quarter of a pound of tar, and a quarter of a pound of turpentine. Let them be well incorporated with the oils, by first heating the whole mass gently, and then immerse the fire till the whole is thoroughly mixed; or he proposes to add to the oil, gums fandaarce, mastic, anime, copal, amber, together or separate, or asphaltum, or one-sixth part of bee's-wax. In short, any bituminous, refrinous, or adhesive matter, which will refit acids, alcalies, and water, and will unite with drying oils, provided when mixed in proper proportions they do not render the leather hard, or make it crack, or otherwise disagreeable.

In the Annales de Chemie, Mr. Hildebrand of St. Petersburg proposes the three following methods of rendering sole-leather impermeable by water.

The first preparation is made by boiling 1½ lb. of minium with 20 lbs. of oil of linseed, or hemp-feed; continue the boiling till the metallic oxides be entirely dissolved, and the mixture attains a carbonaceous brown colour: apply this composition to the inside of the hides till they can absorb no more of it; then dry them, in summer by the heat of the sun, in winter before a fire. When the composition becomes too thick, it may be liquefied by the addition of oil of turpentine.

The second preparation is simply either of the same oils, in part dihydrogenated by fire; it will serve equally well for upper leathers.

The third preparation is a mixture of two ounces of black pitch with a pound of tar, melted together by a gentle heat;
the leather is then anointed with the mixture, and dried. Soles thus prepared ought to be used with the smooth side inwards.

Another receipt for an elastic water-proof varnish is, gum asphaltum, two pounds; amber, half a pound; gum benzoin, fix ounces; linseed-oil, two pounds; spirits of turpentine, eight pounds; and lamp-black, half a pound; united together in a earthen vessel over a gentle fire.

The leather is to be nailed on a board, and the varnish applied upon it: it is then to be paffed into an oven several times, the varnishing being each time repeated, till the leather is completely covered.

Mr. William Baynham took a patent in 1816 for a water-proof varnish, which very much remembles thofe of his predeceffors. It is prepared as follows: fix gallons of linseed oil, one pound and a half of rosin, and four pounds and a half of red lard, or any other substance usually known under the denomination of dryers, are to be boiled together till they acquire sufficient confidence to adhere to the fingers, and drawn out into strings when cooled upon a piece of glass or otherwise. It is then to be removed from the fire, and when sufficiently cooled, thinned to about the confinence of sweet oil, by adding spirits of turpentine to it, which generally requires about fix gallons. It is left to settle for a day or two, and then carefully poured off from the ground; and about one pound and a half of ivory or lamp-black, and one pound and a half of Prussian blue ground in linseed oil, added to and intimately mixed with it. It is then ready for use.

To apply this varnish, flir it up, and lay it on with a brush until it lies on the surface of the leather with an even gloss; then hang up the article which has been operated upon until the next day: repeat the application as before, taking care to leave the surface as thin and even as possible. This must be repeated each successive day, until it has the desired appearance.

**Water, Raising, in Rural Economy.** See RAIr.

**Water-Rocket.** See ROCKET.

**Water-Sail, in a Ship,** denotes a small sail, spread occasionally under the lower fludding-sail, or driver-boom, in a fair wind, and smooth sea.

**Water-Scope, of the Saxon wasserchop,** denotes an aqueduct, drain, or paffage for water.

**Water-Shield.** See HYDRASPI.

**Water-Shoot, a young sprig, which springs out of the root or flock of a tree.**

**Water-Shot, in Sea Language.** See MOORING.

**Water-Spout.** See Water-Spout.

**Water-Table, in Architecture,** is a sort of ledge, left in stone or brick walls, about eighteen or twenty inches from the ground; from which place the thickness of the walls begins to abate. See WALL.

**Water-Thermometer,** a thermometer made with water by Mr. Dalton, for the purpose of ascertaining the precise degree of cold at which water ceases to be farther condensed; and likewise how much it expands in cooling below that degree to the temperature of freezing, or 32°. With this view he took a thermometer tube, such as would have given a scale of ten inches with mercury from 32° to 212°, and filled it with pure water. He then graduated it by an accurate mercurial thermometer, putting them together in a bafon filled with water of various degrees of heat, and stirring it occasionally: as it is well known that water does not expand in proportion to its heat, it does not therefore afford a thermometric scale of equal parts, like quicksilver.

From repeated trials agreeing in the refult, he found that the water-thermometer is at the lowest point of the scale it is capable of, that is, water is of the greatest density at 42½° of the mercurial thermometer. From 41° to 44° inclusively, the variation is so small as to be jult perceptible on the scale; but above or below those degrees, the expansion has an increasing ratio, and at 32° it amounts to 36th of an inch, or about 7.5 part of the whole expansion, from 42½° to 212°, or boiling heat. During the investigation of this subject, his attention was arrested by the circumstance, that the expansion of water was the same for any number of degrees from the point of greatest condensation, no matter whether above or below it: thus he found that 32°, which are 100° below the point of greatest density, agreed exactly with 53°, which are 100° above the foid point; and so did all the intermediate degrees on both sides. Consequently, when the water-thermometer stood at 53°, it was imposfible to say, without a knowledge of other circumstances, whether its temperature was really 53° or 32°. Our ingenious author, recollecting some experiments of Dr. Blagden in the Philosophical Transactions, from which it appears that water was cooled down to 10° or 22° without freezing, was curious to fee how far this law of expansion would continue below the freezing point, previously to the congelaion of the water, and therefore ventured to put his water-thermometer into a mixture of snow and salt, about 25° below the freezing point, expecting the bulb to be burft when the fudden congelaion took place. After taking it out of a mixture of snow and water, where it stood at 32°, (that is, 53° per scale,) heimmermed it into the cold mixture, when it rofe, at firft slowly, but increasing in velocity, it paffed 60°, 70°, and was going up towards 80°, when he took it out to fee if there was any ice in the bulb; but it remained perfectly tranparent: he immermed it again, and raised it 75° per scale, when in an instant it darted up to 128°, and that moment taking it out, the bulb appeared white and opaque, the water within being frozen: fortunately it was not burft; and the liquid which was raised thus to the top of the scale was not thrown out, though the tube was unfealed. Upon applying the hand, the ice was melted, and the liquid resumed its station. This experiment was repeated and varied, at the expence of several thermometer bulbs, and it appeared that water may be cooled down in fuch circumftances, not only to 21°, but 5° or 6°, without freezing; and that the law of expansion above-mentioned obtains in every part of the scale from 42½° to 10°, or below, fo that the density of water at 10° is equal to the density at 75°.

**Water-Tight, in Sea-Language,** the flate of a ship when not leaky.

**Water-Tracing Crescent, in Rural Economy,** the tool formed in the manner of the gardener's edging-iron, but made much larger, and in the crescent form, very thin and well-fleeced, and sharp in the edge, having a flem about three feet in length, with a crofs handle for bearing upon in working with it, in cutting out the sides of the different conductors of the water in watering land. See Watering Land.

**Water-Ways, in Ship-Building,** the fide-frake of a deck wrought next the timbers, and much thicker than the deck, but reduced to the thickness of the deck in front: it makes a channel for the water to run through the scuppers, and prevent leaking at the side.

**Water-Wheel,** an engine for raising water in great quantity out of a deep well. See Persian-Wheel, and Water, Raising of, fupra.

**Water-Workers, in Agriculture,** a term applied to the makers and formers of meadow-drains and trenches, or wet ditches.
chiches, as in the practices of watering and draining of land, or otherwise.

Water-Worm, Reproduction of; in Natural History. See Reproduction, and Water-Worm. See also Vermes.

Water Key, in Geography, a small island in the bay of Honduras, near the coast of Mexico. N. lat. 17° 30'. W. long. 88° 40'.

Water Key, a small island in the Spanish Main, near the Mosquito shore. N. lat. 12° 15'. W. long. 82° 55'.

Water Key, South, a small island in the bay of Honduras. N. lat. 16° 35'. W. long. 88° 45'.

Water Point, a cape on the east coast of Java. S. lat. 7° 55'. E. long. 114° 33'.

Water Sound, a frit of the North sea, between South Ronaldha and Barra, two of the Orkey islands.

Waterborough, a town in the diocor of Maine, and county of York, containing 1395 inhabitants; 5 miles N.W. of Wells.

Waterbury, a town of the state of Connecticut, containing 2874 inhabitants; 20 miles S.W. of Hartford.

Wattere, a water which rives in the Allegheny Mountains, then runs southerly into South Carolina, and changing its name to Watero, after a course of about 120 miles, it joins the Catawba, and then takes the name of Santee.

Waterford, a maritime county of Ireland, in the province of Munster, having the county of Cork on the west, the counties of Tipperary and Kilkenny on the north, the county of Waterford on the east, and St. George's Channel on the south. It extends from east to west 40 Irish, or 51 English miles; and from north to south 23 Irish, or 29 English miles. Its breadth, however, varies much, and is in one part not more than 6 miles. The area is stated to be 262,800 acres, or 410 square miles Irish, which are equal to 425,692 acres, or 665 square miles English. Dr. Beaufort states the number of houses to be 18,796; and the number of inhabitants at least 110,000. The number of parishes is 74, in which there were 21 churches, divided between the sees of Waterford and Lismore. Waterford returns four members to the imperial parliament, two for the county, one for the city of Waterford, and one for the borough of Dungarvan. The county of Waterford is in general hilly, and the northern part is particularly rough and mountainous; in the south and east the soil is rich and productive. In the west of the county, on the north of the Blackwater, there is a ridge called the Knockmealdown mountains, many parts of which are very high, though Mr. Twisf is mistaken in calling them the highest in Ireland. The Comeragh mountains cover a great extent of country between Dungarvan and Clonmel. These hills, except in a few defolate and craggy spots, afford plaiture to small cows, which produce a great quantity of butter. In the eastern part agriculture has been much improved, and the farms are not parcell'd up in any part of Ireland.

The river Blackwater flows through the west of this county into the bay of Youghal, and is navigable to Capponquin. The banks of this river are peculiarly beautiful, especially near Lismore. The river Bride, which joins the Blackwater, passes near the town of Tallow, and is so far navigable for large boats. The gentle and majestic Suir forms the northern boundary, dividing it from the counties of Tipperary and Kilkenny, and running east till joined by the Barrow; when, turning south, they form an estuary, 9 miles long, and 2 broad, which is the harbour of Waterford. At Dunmore, near the extremity of this, on the Waterford side, a very fine pier is building, for the protection of the packet's, and of such vessels as may put into this harbour.

Dr. Charles Smith published "The ancient and present State of the County and City of Waterford," in the year 1745, which was reprinted in 1772. In this work, he states the menapii to have been inhabitants of this county and Wexford in the time of Ptolemy, which Menapii he supposes to have been a colony from the Belgic Menapii, mentioned by Cesar. The Defis are stated to have been a powerful clan at the time of the English invasion. These came from the county of Meath, and gave name to the baronies of Defies within and Defies without Drum, and their descendants are now called Deisy. Though the power of the Deisi was abolished by the English, yet, for many years after, the O'Colains, kings of the Defis, are occasionally mentioned in the Irish annals. Henry II. in 1177 made a grant of the city of Waterford, with all the circumjacent province, to Robert Le Poer, his marshal, from whom are descended not only the family of Le Poer, the head of which was created, in 1555, earl of Tyrone, but also the several respectable families of Power, settled at Clapham, Curtean, &c. By marriage, the estates and honours of the Le Poers came to the family of Beraford, the head of which is now marquis of Waterford, and has a noble seat at Curraghmore, in this county. In the civil war, Waterford had its share of disturbance, and Cromwell himself was engaged unsuccessfully in the siege of its capital. Dr. Smith's Topography is still interesting to the reader, from the various information he collected respecting the different families settled, though many of them are now extinct or removed. His natural history is very defective, yet it is the best hitherto published. He drew attention to the fisheries, and to the Nylon bank, yet even now, though employment is so much wanted, the fisheries remain without encouragement. In his enumeration of eminent men born in this county, we find the names of Congreve the poet, and of Robert Boyle, who was born in the castle of Lismore. The duke of Devonshire, as descendant of the eldest branch of the Boyle family, possesses the towns of Dungarvan, Lismore, and Tallow, with a great tract of land, which gives him a preponderating influence in the county. Beaumont's Memoir of Ireland, &c.

Waterford, a city and sea-port town on the south side of the river Suir, in Ireland, capital of the county of the same name. This river is embanked by a noble quay, extending the whole length of the town, to which vessels of great burden can come up, though the largest ships generally lie a few miles lower down. Like most of the other sea-ports of Ireland, it was originally built by the Oftmen or Danes; and is said to have been founded A.D. 853, nearly at the same time as Dublin and Limerick. Waterford seems to have been the chief settlement of this people, for we find the kings of the Danes of Waterford often mentioned in the old annals. Strongbow, soon after his landing in Ireland, took Waterford by assault in 1171, and in 1172 gave it up to king Henry II., who landed at Waterford, and received there the submission, not only of his English subjects, but also of many Irish chiefs. King John also landed at this city, and made it his residence for some months. The steady adherence of Waterford to the English caused it to be engaged in almost constant warfare with its neighbours, and in return it received many marks of royal favour. Richard II. landed twice at Waterford. When Simnel was crowned king by the earl of Kildare, the lord deputy, the citizens of Waterford refused to admit him, adhering steadily to Henry VII., in consequence of which he addressed a letter to them, thanking them for their adherence, and giving them power to seize the rebels and their effects, and to employ the latter for their own advantage. They behaved with the same loyalty against Perkin Warbeck,
Warbeck, who had many adherents in Ireland, in consequence of which the king gave them this motto, which is still used, "Intacita manet Waterfordie." In the reign of James I., Waterford appears to have become turbulent in consequence of its attachment to the Roman Catholic religion, and in consequence was deprived of many privileges, but were restored by Charles I. In the civil war, Waterford was on the side of the Catholics, and a meeting of the popish clergy was held there by the pope's nuncio in 1646. It was besieged by Cromwell without success; but was afterwards taken by Ireton. It has been already mentioned that Waterford was built by the Danes; it was at first called Portlarcie, from larcia, a thigh; the course of the river Suir, near this place, resembling that part of the human body. The English gave it its present name, as it is said, from a ford in St. John's river, which empties itself into the Suir. The city chiefly faces the north and east, which, though seemingly a situation not so desirable, being exposed to the chilling blasts of these winds, yet the healthiness of it makes amends for the bleakness of the exposure. A further advantage is its noble situation, near the confluence of three large and navigable rivers, the Suir, the Nore, and the Barrow, by which inland commodities may be supplied at a very inconsiderable expense of carriage, from the very centre of the island, and from seven different counties washed by these rivers, and other counties adjacent to them. Over the river Suir, a fine wooden bridge has been erected within a few years, to facilitate the communication with other places. A very flourishing commerce with England and other countries is the happy consequence of such a situation. Its exports of beef, butter, hides, tallow, pork, and corn, are considerable. The number of large hogs weekly slaughtered during the season exceeds 3000 on an average. The quantity of butter annually exported exceeds 80,000 casks.

This city is also largely concerned in the Newfoundland trade. The population is supposed to exceed 40,000, and it ranks as the fourth town of Ireland in extent, and the fifth in commercial importance. Packet-boats are established between this port and Milford Haven, for the convenient intercourse of the south of Ireland with England. This city sends one member to the united parliament, elected by the freemen and freeholders. This election is free, and, to the honour of the electors, for John Newport, one of the most steady friends of Ireland, has been repeatedly returned. The cathedral of Waterford, adorned with an elegant tetrastyle, is a fine structure. There is also a very superb Catholic chapel, with several other places of worship. The other public edifices are constructed with much elegance, and essentially contribute to ornament the city. It is, however, of more consequence to observe, that its numerous charitable institutions are well conducted, and liberally supported. Its house of industry may serve as a model for others. Its fever hospital was the first in Ireland, and nearly the first in the united kingdom, and has been carried on with uniform success. Without any wish to take from the merit of other worthy individuals, much of this praise is due to the exertions of the Society of Friends, who are numerous in Waterford. This city is 74½ Irish miles S.S.W. from Dublin. Smith's Waterford. Carlyle's Dictionary. Wakefield, &c.

Waterford and Lismore, Bishopric of. The first of these sees, which is confined to the easterly part of the county of Waterford, and is very small, was founded by the Ottomans in the 11th century; but that of Lismore, which includes the greatest part of Waterford county, and a considerable portion of Tipperary, was founded in the seventh century. The union took place in 1536. The extent of the union is, in Irish miles, 39 by 29, and in English 49 by 37. The number of Irish acres 354,800, which are divided into 166 parishes. Forty-four of these are inappropriate, and the rest form only 44 benefices, of which, when Dr. Beaufort published his account, only 30 had churches, and only 8 glebe-houses. Many churches and glebe-houses have been built throughout Ireland within a few years. Beaufort.

Waterford, a populous and compact incorporated post-village, in the S.E. corner of Half Moon, Saratoga county, on the W. bank of the Hudson; 10 miles N. of Albany. It is the most populous town in the county, and has the greatest share of trade. It is handomely laid out, in 5 E. and W. streets, intersecting at right angles. It has 190 houses and stores, 2 houses of worship, and some other buildings, together with three schools on the Lancaster plan. It is well situated for a manufacturing town; and in 1812 a wharf, 320 yards long, was constructed, and a canal along it to the channel of the Hudson.

The city of Waterford, in the county of Caledonia, on the W. bank of the Connecticut, formerly called Littleton, containing 1289 inhabitants; 40 miles N. of Norwich.

Waterford, a post-town in the district of Maine, and county of Oxford, containing 188 inhabitants; 95 miles N. of York.

Waterford, a post-town of Virginia; 20 miles N.W. of Washington.

Waterford, a town of Connecticut, in the county of New London; containing 2185 inhabitants.

Waterford, or Le Beuf, a post-town of the state of Pennsylvania, in the county of Erie, containing 162 inhabitants; 370 miles N.W. of Washington.

Waterford, a township of New Jersey, in Gloucester county, containing 2105 inhabitants; 40 miles S. of Trenton.—Also, a town of Ohio, in the county of Washington, containing 701 inhabitants.

Waterguchee, or Waterguechee, a river of Vermont, which runs into the Connecticut, N. lat. 43° 34'. W. long. 72° 18'.

Watering, in Gardening; the practice or means of rendering seeds, plants, shrubs, and trees, as well as gardens, properly and suitably moist for the purpose of their better, more ready, and more healthy germination, growth, and taking root, when sown, planted out, or set, and afterwards for continuing them in the necessary states of vegetation, growth, and increase, especially when the weather is dry, hot, and parching. It is also occasionally useful in preventing some sorts of fruit-trees from being destroyed by the attacks of different sorts of insects, as well as for the clearing them of other kinds. It is occasionally equally essential for the seeds and plants in the full ground, as for those in pots in it, and those in green-houses, glass-houses, hot-beds, hot-houses, stocks, and other similar situations; such, for instance, in the former kinds, as the seeds in drills, beds, and other open places, different young plants in the same situations, numerous others of the cutting, slip, offset, and other similar kinds, which have been newly pricked out, planted, or transplanted, not only at the time of first putting them out, but now and then afterwards, when dry or hot weather is prevalent; also in many kinds of newly-planted young trees and shrubs in the spring and early autumn plantings; and to all the plants which are in pots in the open air, whether they may be of the more or less hardy kinds, during the dry, or hot weather of spring, summer, and early autumn; and in the latter description, to all the fine tender kinds.
kinds of potted plants and trees under any fort of covering or protection of the house or other kind.

There are many sorts of plants which cannot exist without watering in either a small or plentiful manner. Some stand in need of it only in a flight degree, and at particular seasons of the year, while others demand it in very full proportions at all times. Some are very nice in the quantities which are required at any one time; but others are less particular in this respect. Some too are under the necessity of having it thrown over their leaves as well as to their roots; others only have occasion for it to the root part. And there are some other methods of administering and applying it, which are peculiar to certain kinds of plants, trees, and other vegetable products, as shown under their particular individual modes of culture.

In all cases, the most proper water for this use is that which is contained in any fort of pond, reservoir, or other smaller kind of excavation, for the purpose of containing it in a flake of constant exposure to the atmosphere, in gardens or other places, as it is not only more convenient and ready for being employed, but, at the same time, a great deal more salutary, and better adapted to promote the growth and increase of the different sorts of plants and vegetables, than that of the raw, sharp, cold, hard kind, which is drawn from wells or raised by pumps for immediate use, as being more soft in its nature, and more suitable in its temperature.

The most suitable time of applying it is in the evening, after the disappearance of the sun, and when the excessive heat of the day is gone off, and in a great measure abated, as its effects are then more beneficial and lasting; and besides the work can be performed with more ease and convenience, as well as in a more agreeable manner.

When once the usefulness of watering has been commenced, it should always be regularly proceeded with, or the plants or vegetables may suffer much, and be greatly injured by the omission or neglect. It is constantly better never to attempt it, than to just begin and then leave it off again, as is much too frequently the case, in the practice of horticulture, with some gardeners, who have not fully considered the matter.

The work of watering feeds, plants, shrubs, and trees, is usually performed, either by means of common watering pots and cans, large syringes contrived for the purpose, forcing engines for throwing it up over the plants, or by some other contrivance of a similar nature. The water being mosty brought to the places where it is wanted, either in tubs hung in a fort of barrow-frame, or by their being placed on the barrows themselves.

The water is commonly applied in a fine divided flake, over the plants, where it is not required in any large quantities, and for clearing away and destroying faults; but where it is demanded in large proportions, it is often poured in full firdm to their roots or other parts.

But in using it upon a large scale for garden-grounds, Mr. London has suggested that it may be accomplished by a practice somewhat similar to that of overfowing tillage-land, or by means of subflooding; this last may, he thinks, be effected by having a stratum or layer of gravel underneath the whole garden, which by having a trench围绕 it, or, if upon a slope, at the upper side of it only, may have the ground wholly saturated with the water let into it, which will soon be absorbed and taken up by the incumbent surface containing the vegetables that are under cultivation. And, in the former of these methods, by having pipes, open-cuts, or rather small wooden troughs, which may serve to convey and conduct the water upon the surface of every quarter of the ground; it may there distribute itself in the intervals between the beds or drills, as well as over the general surface of the broad-cult crops. It is further suggested that the former method could be put in practice at any period of the spring or summer; the latter, for the moist part, in moist weather, or in the night season. See WATERING of Land.

In the watering of both seeds, plants, and garden grounds, much care should, however, be taken, in every instance, that injury instead of good be not done, by employing too large quantities, or continuing them for too great a length of time.

On the whole, it will be evident, from what has been said above, that the practice of watering in garden culture may be beneficial in different ways, as in exciting and promoting a better and more speedy vegetation in newly-sown seeds and transplanted vegetables; in forwarding the growth and increase in a proper manner of different crops, plants, and trees; and in the destruction or removal of insects, such as the aphids, red spider, and some of the coccus tribe.

WATERING-Barrow, in Gardening, such as is employed in conveying water to gardens or other places. They have usually a tub fixed upright in the frame by means of pivots, hooks, and gudgeons, or some other way, one-half of which is below and the other above it, the water being, in a great measure, prevented from spilling while it is carrying. See QUENDON Water-Barrow.

WATERING Forcing-Engine, an engine contrived for the purpose of forcing water in a fort of shower over some kinds of fruit-trees, garden vegetables, and plants, and which commonly effects the businefs in an easy, convenient, and effectual manner, being well adapted to particular modes and purposes of watering.

WATERING of Land, in Agriculture, the practice of over-overflowing it artificially in the grâfs flate, with the water which is diverted from an adjoining or neighbouring river or stream, which has a higher level than the ground to be covered, or where there is a proper fall. In this way, by the newformed water-courts being kept nearly on the level, the spaces of land between the new and the old channels may be watered, the water being brought upon the ground by the former, and discharged or taken away by the latter; and thus a constant succession of the water be retained and removed without such an accumulation of it as would be injurious, or such a deficiency as would leave any part imperfectly supplied. In different districts different names are applied to this practice, such as those of floating, flooding, drowning, soaking, and some others.

It is, without doubt, a practice of great antiquity, which it is probable the extraordinary fertility afforded by the annual overflows of the river Nile, in Egypt, may have first suggested as the means of improving the lands of other countries. In this country, indeed, it would seem to have been had recourse to, for the purpose, at a very early period, as in the county of Hereford, it appears to have been practiced more than two hundred years ago, as is evident from a work on the subject written by Rowland Vaughan, and published in the year 1610, entitled " Most improved and long-experienced Water-Works; containing the manner of summer and winter draining of meadow and pastures, by the advantage of the leaf river, brook, fountain, or watermill adjacent; thereby to make those grounds, especially if they be dry, more fertile than ever." And the practice is probably still more ancient in the county of Wilts than in the above or any other district, in consequence of its polishing naturally watered grass lands, which perhaps first led
to the notion of forming them in an artificial manner. The general want of good pature-grounds in the high lands of this county might, it has been supposed, be a great inducement to improve such watery valley-tracks, which must ever have displayed the most pleasing and interesting appearances of early luxuriant vegetation and growth.

However, in whatever way the practice originated in this country, it is unquestionably a method that is deserving of the attention of the land proprietor and the farmer in a very high degree.

It has been flated by different writers on the practice of watering land, that the most proper qualities of the grounds for being watered, are all those which are of a sandy or gravelly friable open nature, as on such the improvement is not only immediate, but the effects produced more certain and powerful than on other kinds of them. There are also some strong adhesive four wet lands, which are also capable of being improved by watering.

There are still some other sorts of lands, as those which contain different kinds of coarse vegetable productions upon their surfaces, such as heath, ling, rushes, boggy and other aquatic plants, which may likewise be much improved by watering. It should, however, be constantly kept in mind, in attempting this sort of improvement, that the more flill and tenacious the soil or land is, the greater the command of water should be, in order to effect the purpose.

The lands which admit of this sort of improvement with the most success and benefit are, for the most part, all such as lie in low situations on the banks and borders of brooks, rivers, and streams, or in sloping directions on the sides of hills, to which water can be conducted in an easy and ready manner.

The writer of a late useful tract on the subject, however, seems inclined to suppose that there are only a few foils or sorts of land to which watering may not be advantageously applied; the experience which he has had, it is said, has determined, that the wettest land may be greatly improved by it, and likewise that it is equally beneficial to that which is dry. But that as many persons, unacquainted with the nature of watering land, may be more inclined to the latter supposition than the former, the reason of wet land being as capable of improvement by watering as that which is completely dry before it is used, is explained. It is that, in the constitution of all watered meadows or lands, particular care must be taken not to render them perfectly dry when the buffets of floating or covering them with water shall terminate; and that the seafon for floating or watering is in the winter and not in the summer, which those who are unacquainted with the process have too commonly supposed. All bogs of the peat kind are certainly, it is said, of vegetable origin, and those vegetables are all aquatic in their nature. It therefore follows that the same water which has produced the vegetables of the bog would, under due management upon the surface, produce such grases or other vegetables as are usually grown by the farmer; and the writer has hitherto had reason to think, that this may be considered as a general rule for determining the situation for any experiments or trials with water. The writer having succeeded in the attempt to make good watered lands, upon foils which have been thought unfit for the purpose, and floated or watered them with water that was equally condemned, in point of quality, he is now, it is said, sufficiently emboldened to recommend the trial of watering land by means of machinery, and that the most flattering hopes of success are entertained from it. It is noticed that the grases produced by the first year's floating or watering of a peat-bog, or any wet land, will be much more like what will become the permanent herbage of a water-meadow, than the first or second year's crop from a newly-floated or watered piece of dry land. The herbage of the former being, it is said, previously floored with aquatic plants, is in some degree suited to this new state, whereas the herbage of dry land is generally of quite a different nature, and often produces an exceeding great crop of grases the first year, which does not appear the next; for the same water which caused these grases to grow so very luxuriantly the first year, will totally destroy them in the course of the ensuing winter, and produce an herbage much more congenial to that degree or state of moisture. The utility of watering in all these cases has been fully established in several different districts, so that proper examples of the forms and crops may always be readily had for the trials of others in the same way. This has been done, it is said, in the counties of Bedford, Norfolk, and Kent, in the first and last of which upon foils that are very different from those of most water meadows in the county of Wiltz; and that the floating or watering of them has been effected with water which was always before considered to be wholly unfit for that purpose, even by those supposed to be the best acquainted with the practice; it is now, however, fully proved and shown to be the case, not only by the accurate investigations of the most able chemists, but by the extraordinary growth of grases in particular boggy situations, that waters of the ferruginous kind are not at all hurtful to vegetation; but, on the contrary, very friendly to it, when they are properly applied. Such facts being established beyond all possibility of doubt, afford, it is said, a much greater scope for the improvements by water, than was ever expected or thought of by the most fanguine advocates of watering, and enables the writer, from his great experience and observation, in different parts of the kingdom, to say that there are few districts to which they are not applicable.

It is, however, supposed by some, that the quality of the water, like that of marl or other manures, is a matter of the first importance, and should be particularly ascertained. And it has been remarked by the author of the "Treatise on Landed Property," that it is universally known that water which flows out of a dung-yard pollicies a fertilizing quality. It is generally admitted, too, that the washings of heep-walks, freshly-manured arable lands, streets of towns, roads, and other such places, after a long drought, have the quality of fertilization. And it is equally evident, it is thought, that the waters inflowing in different parts of the kingdom from chalk, lime-flone, marl, or other calcareous ferritum, though they be perfectly limpid, possess the power of fertility; and those of some districts, as of Wilts, Dorsetshire, and some others, to an astonishing degree. And a similar, though less powerful, effect is produced by the limpid waters, which influe from the slate-rocks of Devonshire and Cornwall. On the other hand, waters that ooze out of peat-bogs, and influe from particular mines, are well known to be injurious to the growth of agricultural vegetables.

It is added, that chemistry points out tests and processes whereby waters, as well as marl and other gross manures, may be tried and analyzed. But the virtue of water, when considered as a manure, does not reside in a single principle, like that of lime-flone. Water is capable of fulpanding, not only calcareous earth, but various other matters,—of animal, vegetable, and fossil origin: some of them friendly, others insinual, to vegetation. It would, therefore, it is thought, be imprudent in a practical man in this business to commit himself to theoretic guidance alone, while the theory of manures, and especially of watering land, remains so much involved.
WATERING OF LAND.

...and while trials in the field, on the very land which is desired to be improved, may be made with facility and prompt decision.

The effects of watering are remarkable in many instances; in Wiltshire, it is not uncommon to see, it is said, lands, where water has been diverted for the purpose of improvement, divided by a hedge or a ditch only, the grass on one side of which is of the most luxuriant nature and abundant growth, but on the other so diminutive that the strongest blades have never reached the height of three inches. The same is the case in other situations, which sufficiently marks the importance of the practice.

It will be necessary, before we state the different methods of performing the business of watering in different circumstances, to give some account of the implements which are requisite for the purpose, as well as some explanation of the terms employed in carrying on the work in the different modes. The first and principal instrument in the execution of the work is a proper level, of which the spirit one is perhaps the best. It is necessary for taking the level of the land at a distance, compared with the part of the river or other stream, from whence it is intended to take the water, to know whether it can or cannot be made to float the part designed to be watered. It is particularly useful in works of this sort on a large scale, although the labourers too frequently neglect the use of it, bringing the water after them to work by in-cutting the several parts that are to convey the water. It should, however, be most used as being more certain and correct. See Level, and Water-Level.

A proper line and reel and cutting-iron are likewise absolutely necessary, as well as a breast-plough, which should be of the best kind, as being of great use in cutting turf for the sides of the channels and other parts. See Water-Line and Reel, Water-Crescent, and Breast-Plough.

The spades used in this sort of work should have the handles considerably more crooked than those in common use, the bit being of iron, about a foot in width, in the middle, terminating in a point, a thick ridge running down the middle part, from the top to near the point; the edges on both sides being drawn very thin, and kept quite sharp by frequent grinding and whetting; when they are become thin and narrow by wearing, they are used for the smaller trenches and drains. By means of the handles being made so crooked, the workman, standing in the working position in the bottom of the drain or trench, is enabled to make it perfectly smooth and even without any difficulty.

Both short and narrow leys are also necessary, in order to mow and cut away any weeds or superfluous grass that may be present, during the running of the water in the trenches or other cuts; as well as forks, and long four or five-tined crooks or drag for pulling out the roots of the stuges, rushes, reeds, and other such matters, that may be in the large mains or other channels. These crooks should be made light, and have long shafts to reach wherever the water is so deep that the labourers cannot work in it, so as to remove such obstructions.

Wheel and hand-barrows, too, become necessary and useful, the former for removing the clods and earths to the flat or hollow places, for this use they may be made open, without fides or hinder parts; the latter are used where the ground is too soft to admit the former, and where the clods or other matters require to be removed during the time the land is in water. But when large quantities of earth are wanted to be removed, especially when to be conveyed to some distance, three-wheeled carts are proper.

And in all cafes a stout large water-proof pair of boots is absolutely requisite, having the tops made so as to draw up half the length of the thigh; they should be large enough to admit a quantity of hay or other such materials to be flung down all round the legs, and be kept well tawlowed, in order to refill the running water for any length of time.

The termes used in the practice of watering are very numerous. A weir is a work thrown over or across a brook, river, rivulet, stream, main, or other such parts, the use of which is to divert the water; and when the hatches are all properly adjusted and in their places, to flop the whole current, in order that the water may rise high enough to overflow the banks, and spread over the adjoining land; or, by stopping the water in its natural course, turn it through mains or channels, cut to convey it another way, to some distant lands that are to be watered. See WEIR.

A sluice differs from the above simply in having but one thorough or opening, as when there are more than one it becomes a weir. It is applicable in small streams in the same way that the weir is in large ones. See SLUICE.

The covered sluice or trunk is constructed and had recourse to in all such cafes, as where two streams of water are to cross each other at the point of discharge, and to serve as a bridge. The drain-sluice or trunk is that which is placed in the lowest part of a main, near to the head as it can be formed, and put low enough to drain the main and other parts. It is put with the mouth at the bottom of the main, being let down into the bank; and from the other end of which a drain is cut to communicate with some trench-drain that is the nearest. It is used for carrying off the leakage through the hatches when shut down, to convey the water to other grounds, and for some other purposes. See SLUICE.

Hatches are flood-gates, and used for the same purposes: they are consequently differently formed in different cafes; but such as have about a foot to take off, and let the water pass over so much of them, are thought useful by some in different cafes of watering. Others suppose them the best when made whole and of good timber. See HATCH.

A carriage is a sort of small wooden or brick passage, built in an open manner, for the purpose of conveying or conveying one stream over another, and is useful in many cafes, though very expensive in the practice of watering.

Head-main in watering land implies that part of the principal cut or channel which takes the water first out of a river or stream, and conveys it to such lands as are laid out for the purpose, by means of smaller mains and trenches. It is necessarily formed of various breadths and depths, according to the quantity of land to be watered; and to the length, or the fall of the ground it is cut through. Small mains are the next order of cuts for the distribution of water on lands, as connecting between the head-main and trenches. These smaller mains are mostly taken out of the head-main; and the only difference between them is, the one being much less than the other; they are commonly cut at, or nearly at, right angles with the other, though in some cafes at many degrees lefs. The use of both these sorts of mains is to feed the various trenches and gutters that branch out in all parts of the land with water, and to convey it for floating the ground in an equal manner. By some these smaller mains are termed carriages, but improperly, as it is confounding them with the open trunk so named, as already seen.

The trench, in watering, is a shallow narrow cut or ditch made to take the water out of the mains for floating the land. It should always be drawn in a straight line from angle to angle, with as few turnings as possible. It is never
never made deep, but the width of it must be in proportion to the length it has to run, and the breadth of the pane of ground between that and the trench-drain. It should constantly be cut gradually narrower and narrower, in the wedge-form, to the lower end, in order to force over the water more equally.

The trench-drain is constantly cut parallel to the trench, and as deep as the tail-drain water will permit when necessary. It should always, where possible, be cut so as to come down to a firm stratum of land, gravel, or clay. If the flail, a spade’s depth into it will be of great benefit. The use of it is to take away the water immediately after it has run over the panes of the land from the trench. It is not necessary to be brought up to the head of the land by five, six, or more yards, as the nature of the soil may be. The form of it is the reverse of the trench, being narrower at the head, or upper part, and gradually wider and wider, until it comes to the lower end, and empties itself into the tail-drain, which is a receptacle for all the water that comes out of the other drains, that are situated so as not to empty themselves into the river; and, consequently, it should run nearly at right angles with the trenches; but it is, in general, preferable to draw it in the lowest part of the ground, and to use it for conveying the water out of the ground where there is the greatest defect: this is commonly found in one of the fence-ditches; for which reason a fence-ditch is mostly made use of for the purpose, as answering the double use of a fence and drain at the same time.

The pane of ground is that part of the land which lies between the trench and the trench-drain, and is the part on which the grass grows, which is cut for hay: it is watered by the trenches, and laid dry by the trench-drains; consequently there is one on each side of every trench. The term pane is also applied to the part which is used, for taking off the produce.

The bend implies a slopage made in different parts of such trenches as have a quick descent, in order to obstruct the water. It is effected by leaving a narrow slip of greenward ground across the trench where the bend is designed to be, and cutting occasionally a small part out of the middle of it in the wedge form. It is useful for checking the water, and forcing it over the trench on to the panes; which, if it were not for such bends, would run rapidly on in the trench, and not flow over the land as it paffes along.

The great art of watering land consists in giving to every part of each pane of ground an equal quantity of water, which is greatly promoted in this way.

The gutter is a small groove cut out from the tails of these trenches, where the panes of ground run longer at one side or corner than the other. The use of it is to carry the water to the extreme point of the panes. Those panes which are intersected by the trench and tail drains, meeting in an obtuse angle, want the affittance of these gutters to convey the water to the longest side. And another use of them is, when the land has not been so perfectly levelled but that some parts of the panes of ground lie higher than they should, a gutter is then drawn from the trench over that high ground, which would otherwise not be overflowed. Without this precaution, unless the flats were filled up, which should always be the case when materials are to be had, the water will not rise upon it; and after the watering-season is past, those places would appear of a ruddy-brown, while a rich verdure would overspread the others; and at hay-time the grass in those places would scarcely be high enough for the scythe to touch it; while that around them, which has been properly watered, will, from its luxuriance, be laid down. This neglect is, therefore, to be reprobated in most cafes, as the great art of watering land is that of throwing the water regularly over all parts, those where it cannot rise of itself as well as others, and in carrying it off from those in which it would otherwise stagnate and be hurtful.

The catch-drain is an occasional ditch, sometimes cut for the purpose of carrying the same water into a second main or other part, for watering lower lands or panes of ground with the water that has been before used. It is made use of in some other cafes, as catching the water that is thrown forward.

Pond is used to signify any part where the water stands on the ground in watering, or in the tail-drain, trench-drains, or others, so as to injure the lands near them; and is occasioned by flats and irregularities in the surface of the grounds, as well as by other causes.

The turn of water means the space of land that can be watered at one time in any cafe; and is accomplished by shutting down the hatches in all those weirs where the water is designed to be kept out, and opening those that are to let the water through them. The quantity or extent of land to be watered by one turn, must of course vary with the size of the river, brook, main, and other such parts, and by the plenty or scarcity of the water.

The bed of a river, main, trench, or other such part, is the bottom of any of them.

The head of any watered land is that part into which the river, main, or other such part, first enters. And the tail of it is that part where the water bail paffes off by the tail-drain into the coufle that is to take it away.

The upper side of a main or trench is that which, when they are made at nearly right angles with the river or other such part, fronts the place where the river, &c. entered. And, of course, the lower side is the reverse.

The upper pane of the land is that which lies upon the upper side of the main or trench when made at right angles with the river, &c. running north and south. Where, however, these run parallel with the river, &c. the panes on either side are not distinguished from each other.

Some other terms, which are used by the more modern writers on watering land, will be explained as we proceed in pointing out the nature of the business.

After noticing the manner in which water is artificially brought on and taken away from the land in watering, as already feen, the writer of the tract before alluded to remarks, that the art of watering land may properly be called floating, not foaking or drowning. Soaking the soil, similar to the effects produced from a shower of rain, is not sufficient for the general purposes of watering; nor will damping up the water, or keeping it stagnant upon the surface, like that in a pond, or on the fields, produce the desired effect. The latter, it is thought, may properly be termed drowning, because it drowns or covers all the grasses, thereby iending the plants beneath it certainiy aquatic, or the herbage disposed to take on such a change; whereas the herbage of a watered meadow or land should, from the form and circumstances of the ground, enjoy the full benefits of air and water. Practice has proved, it is said, that there is no better method of effecting this, than by keeping the water paffing over the surface of the land with a brisk current, but not so brisk as to wash away the soil, and yet in sufficient quantity to cover and nourish the roots, but not too much to hide the flouts of the grasses: hence appears the nicety of adjusting the quantity of water; and hence it appears, too, that one main-drain, to bring the water on the upper side of the land, and another on the lower
lower side to take it away, will not be adequate to all the purposes of such an accurate regulation. If the space between the upper channel, or main-feeder, and the lower one, or main-drain, should therefore be wider than what is proper for the due adjustment of the water, that is, so that every part of the space may have enough of water passing over it, and no part too much, then that space must be divided into smaller spaces by intermediate drains, which may catch and re-distribute the water. Thefe, and the ground capable of being watered in this way, have this term applied to them, as they catch or collect the water and re-distribute it, being in well-formed lands never made more than eight or ten yards apart. As the water is brought by the main-feeder upon the higher side of a piece of ground, which slopes towards the main-drain, and down which flowing surface the water will very readily run, to persons acquainted with watering, it does not at first sight appear necessary to make such a number of intermediate catch-drains; but it is proved by experience, that however regular the slope of ground may appear to the eye, the water will find a number of irregularities, force itself into gutters or channels, and defeat the purposes of watering, in the hollow places by excess, and in the high ones by the want of water. Hence the water that was scattered over the surface of the first space, being all collected in the catch-drain, may, by the skill of the floater, be let out upon those parts of the bed of ground below, which seem to need the greatest assistance.

As it is essentially necessary to profess full and complete command of the water in all cases of improvements of this nature, the works for the purpose should always be well-formed at first. Temporary means of making dams and hatches to divert the water out of its usual channel may, it is said, by the writer of the tract on watering land, suffice to try an experiment, or for a tenant who has but a short term in the ground to be watered; but every land-owner, or other proprietor, who enters upon or undertakes such works in this temporary manner, falsely mistakes his own interest; indeed, it is frequently more difficult to repair than to renew upon large streams, where the foundations are not seldom destroyed or very greatly injured by the force of the water. The same principle holds good upon small streams, and even in the feeders and drains of watered land. Wherever the channels are so contracted as to make a fall, or much increase the rapidity of the stream, it is constantly disposed to wear away the sides of its channel, or undermine a dam. The repair of these defects will stand in need of land to be dug away and wafted each time, they are replaced with the loss of labour. The consequent ill-management of the water renders it more advicable, and perhaps cheaper, to make all such works of masonry. When works are well done at first the owner ever finds a pleasure and satisfaction in viewing them; and even the labourers feel much more interest in their good management, which is a circumstance not to be overlooked.

In the undertaking of business of this kind, it is necessary, before entering upon its execution, to fully consider whether the stream of water to be made use of will admit of a temporary weir or dam to be formed across it, so as to keep the water up to a proper level for covering the land without flooding or injuring other adjoining grounds; or if the water be in its natural state sufficiently high without a weir or dam, or to be made so by taking it from the stream higher up, more towards its source, and by the conductor keeping it up nearly to its level until it comes upon the meadow or ground. And still further, whether the water can be drawn off from the meadow or ground in as rapid a manner as it is brought on. Having, in addition to all these, too, an attention to all such other difficulties and obstructions as may prevent themselves, from the lands being in leafe through which it may be necessary to cut or form the mains or grand carriers, from the water being necessary for turning mills, from the rivers or brooks not being wholly at the command of the floater, and from small necks of land intervening, so as to prevent the work from being performed to the greatest advantage, the operator may be in a situation to commence his works.

The water being thus under full command and regulation in every part of the land to be watered, by a proper direction, use, and form of the works, it is supposed necessary, in order to have an equal distribution, and prevent the waste of it, that no part of the meadow or land, either in the bed or catch-work mode, should be so formed as to be floated or watered directly from the main-feeder; but that all the main-feeders should be kept high enough to discharge the water into the small feeders with considerable velocity, and through a narrow opening. The motion of water is said to be truly mechanical; and that it requires a great deal of ingenuity, and a perfect knowledge of lines and levels, to make it pass over the ground in a proper manner. Each meadow or portion of land requires a different design, unless the land-owner or tenant makes up his mind to the heavy expense of paring off banks, and filling up such hollows as may be necessary to reduce it to some regular method, the construction to be varied according to the nature of the ground. This constitutes the difference between the watered meadows or lands of Berkshire and those of Devonshire. Those of the latter county being upon small streams carried round the sides of the hills, and are chiefly in catch-work; those of the former are near large rivers and boggy ground, being thrown up into ridges to create a brisk motion in the water; and also for the especial purpose of drawing off the superficial moisture which might be injurious to the grasses when shut up for feeding or mowing. Where there is much floating to be done with a little water, or rather where the great fall of a small stream will admit of its being carried over a great quantity of ground, and used several times, it is desirable to employ it in such a way, though meadows or land so watered are not to be considered as perfect models. If it should answer the purpose of a coat of manure upon such an extent of ground, it is all that can be expected, and will amply repay the expense. In all cases, losing fall is wasting water. All the drains of watered meadows or lands require no greater declivity than is necessary to carry the water from the surface; therefore, the water should be collected and used again at every three feet of the fall, if it be not catch-work. It is sometimes difficult to do this in bed-work lands; but where the upper part of the land is catch-work, or in level beds, and the lower part not too much elevated, it may be done. By collecting and using the water again in the same piece of ground before it falls into the brook or other course, a set of hatches is used, and it is not necessary to be very particular about getting the upper part into high ridges, since that part of land which is near the hatches generally becomes the belt, and the lower end of the field being often the wettest or most boggy in its natural state, requires to be thrown up the highest. If the land be of a dry absorbent nature before floating or watering, it is not necessary that it should be thrown up into high beds. There are many good meadow lands in the county of Wilts that have little work in them, and some that have neither feeder nor drain; but these are extraordinary situations that do not occur in almost any other
WATERING OF LAND.

other county, or they must, it is thought, have suggested the ideas already stated as to the origin of floating or watering. There is some reason, it is thought, from the natural warmth of peat-ground, which keeps it from freezing, that such land will produce an earlier crop of spring-feed than any other. At all events, it will first shew the advantages of watering, and gravel or sand may the next to it.

It has been suggested that if grass-land of the heavier kind could be ploughed in such a manner as to let the two furrow-flodes or foids in a leaning position against each other with the grass sides outwards, the roots of the grasses would be perfectly dry all winter; the flotes would have the full benefit of the sun, and great advantage from mutual shelter. Upon wet land, this ploughing should be done the way the water runs. If the ground ploughed in this form before winter could be watered toward the spring, so as to give it a good soaking, it might be ploughed down again to a level surface with a heavy roller. If these narrow ridges, too, were crossed with level trenches at every forty, fifty, or one hundred yards distance, according to the fall of the ground; and these trenches made to communicate with other main trenches, which should run up and down the slope, and supply or discharge the contents of those which are horizontal, such ground might be laid dry or wet at pleasure. And it is believed, that land so shaped might be floated or watered all winter with stagnant water to its great benefit, and probably in the spring, too, if the water be changed at frequent and proper periods, for the water would remain only in the furrows, where there would be little or no vegetation, and the newly boiled soil of the ridges could not fail to absorb moisture, such as would promote the growth of the grasses without any danger of putrefaction. The levels must be taken before a piece of ground be ploughed in this shape, and the earth taken out in cutting the cross-drains, as used in ploughing the furrows on the lower side of them. Perhaps upon wet lands it would be necessary to re-plough them every autumn, or the strong lands might become too solid to receive the same benefit from the practice; and it will be necessary to level the ridges every spring, if the ground be moved, but if summer-fed, it may as well remain in this form as any other. This easy method of getting land up into ridges, which are very narrow, gives to the surface all that inclination which is necessary for drawing off water, and is certainly so far likely to answer the purpose of watering. The water is thus under the same command as in any of the belt-formed meadows or lands, and a much less quantity will be sufficient than under any other plan of watering. It is supposed that it might, probably, answer the purpose to float young wheat, or any other sort of grain, in some cases, by a similar method. It is thought that flat peaty ground, such as the level fens in Norfolk, which are subject to be covered a few inches deep every winter with stagnant water, would be much benefited by ploughing in this way before the floods commence. Some parts of it would thereby be raised above the water, and vegetate quicker in the spring, and the fedge matter growing up in the furrows, would in a few years raise them to the same level. The cross-drains, where on a declivity, would serve to catch and re-distribute the water, and the fall from one to the other must be very little. If this method be found not to do for watering, it is thought that four furrow-ridges of turf, with a small feeder upon each, would answer all the purposes of a more expensive system. There is always good grass by the side of the feeder, whether the water rushes over it or not, and a meadow or land of this nature would be nothing but feeders. It requires so little elevation of ridge and fall in the feeders, that the water might soon be used again; therefore a very small quantity would suffice; and if there was a scarcity in the winter, the whole discharge might be stopped, and gradually lowered in the spring. This method would answer all the purposes of complete saturation, which seems to be one of the most essential parts of watering, and might be applied more or less, according to the time of the year. When the water is put on, it is supposed no grasses would suffer any injury by exclusion from the air for a day or two at the first application. If these ridges could be elevated but four or six inches above the furrows, it would give the surface nearly the same slope as the wider ridges of common meadows or lands; perhaps it would be better to begin ploughing the furrows wide at the ridge, and very narrow at the furrow, which would leave but narrow spaces for drains. If a piece of turf-ground were ploughed in such ridges by the common way of turning over the furrow, if it were set pretty much on edge, it is thought the grass between would soon cover the whole surface.

Ridges, too, might perhaps be made by beginning the two first furrows more apart than the usual width, thus leaving the width of one furrow between the two first to constitute the channel of the feeder. These ridges should be ploughed up and down, with only three or four inches fall between the cross-feeders; and the water may be brought into use again at every other set of beds. If the ground require to be loosened every year, or every other, or two years or more, it will not be attended with much expense, and there will be no very great inconvenience in mowing ground in this shape, if the sides of the ridges be about a foot wide. It is thought that meadows or lands of this fort might be made for twenty-five or thirty shillings the acre, floated or watered with less water than catch-work, and have many advantages over it; namely, the water would lie more above the surface, would be more at command, and therefore changed more readily, and it may be pent up better to get a good soaking when scarce. This may be done more effectually in turns, and will run drier when the water may be taken off. It does not require much skill in the making or management. All the water will be let through nicks instead of running over a nice level edge, which in the first place is seldom made well, and in the next is difficult to keep in repair. This fort of work would, it is thought, have all the advantages of drains and feeders, whereas the same channels are obliged to serve for both in the common catch-work; it would require but very few or no stops, and consequently want but little attendance. It might be practised where there are six or eight inches of fall between the cross-feeder and cross-catch, as the water of each ridge, which should be short, may be let out by a sod with less trouble in the regulation than catch-work. See Drain.

The whole of the channels and drains for carrying the water on or off the land, in the confluent course and regular quantity which practice proves to be necessary, have two very distinct uses. The first fort or feeders bring a continued supply of water to make the slopes wet; and the latter by carrying it away, prevent the land from getting too wet in the time of floating or watering, and serve to render it dry when that operation is over, and to remove any superfluous moisture which may leak from the soil or fall from the clouds. The large ones which convey the water to the land, and along the main ridge to supply the others, are sometimes said to be the main feeders; and the branches that run along each ridge and distribute the water down the sides, the floating feeders. The first operation of floating or watering begins, or ought to begin, at the edges of these feeders; the main feeders being nothing more but channels or courses along
WATERING OF LAND.

Division of Watering.—The practice of watering land may be divided or distinguished into two principal heads or modes; as those of performing it in flat work or flat-flooding, and in sloping or catch work. Each of these divisions has, however, many varieties in the methods of executing the business, as will be seen below.

In the former, or that of watering lands in flat-flooding, there must be a full supply of water, which serves only one turn, and is then carried off the field. There should be a very moderate but uniform declivity in the surface of the land, and the requisite expense be incurred by the undertaker. But though in such works a very small gradual declination will mostly be sufficient, there will be considerable variety in this particular, according to the actual form of the land. The most desirable and perfect declivity for this purpose has been found to be in the ridges, from the upper to the lower extremities of the field, one inch in every nine yards. With this gentle fall, the water passes over by the mere contraction of the feeder, without any stop; but such exact declivities are seldom had. It is also found that the declivity of the sides of the ridges, from the crown to the furrow, should be about two inches for every yard; so that, supposing the ridge to be ten yards broad throughout, and every side to be in the form of an inclined plain, declining in this proportion, the crown may be ten inches raised above the furrow, measuring by the surface at each part. In these proportions, however, there is great actual variety. It is by no means uncommon to find the ridges fourteen yards wide; and when the water is very scanty, they are sometimes twenty yards in width. Where there is a full stream of water, the narrow ridges are found to produce the greatest crops in proportion; but the expense of forming them is likewise greater. Where the field or land has an uniform surface, and the declivity suits, one principal feeder may serve the whole. It is to be cut so as to be the widest at the upper end, contracting all the way as it descends. Notches are to be cut in the bank on the side next the land, and a notch opposite to and communicating with each of the lesser feeders, in order to supply them all in succession with water. These smaller feeders, too, are to be formed so as to be the largest at the heads, contracting gradually as they descend, until near the lower end of the ridge, when the small feeder entirely disappears. The corresponding small drains are made somewhat less than the feeders, though not much less, and the proportions of the drains are revered, being formed the largest at the lower ends, and diminishing into scarcely any thing at the upper ends.

But though the surface of the field or land should be uniform, yet if the descent in the line of the principal feeder be too rapid to admit of its giving supply to the lesser feeders, in a regular manner, without great stopps or hatches, the method below may in that case be had recourse to. The main ditch may act as a conductor only, not as a feeder; and parallel to it the main feeder may be formed in several different parts, each of which is easily levelled up, so as to supplylive or fix ridges, and is itself supplied from the conductor, by simply adjoining a stop or hatch for every subdivided feeder. If the surface should consist of separate and gently rising terraces, there must be a main feeder branching away from the conductor to supply every aspect, on the top of which this feeder is formed; while a corresponding drain is cut at the bottom, and the respective ridges are marked out and formed between the feeder and the drain.

If it should be necessary, some catch-work may be intermixed, so as to water the irregular portions of surface, which positions a degree of declivity answering to that mode of
of watering; and too much of it to be convenient and properly watered in flat flooding. The ridges being formed, and all the feeders and drains cut out, and their materials placed and disposed in such a way as to render the surface as regular and correct as can at first be done; the feeds of proper gradual should in some cafes be fown, but in others it will be unnecessary. When the land is ready in the spring, the feeds may be sown with a thin crop of some early grain kind, but it may be as well to sow the feeds alone towards the beginning of the autumn if the land be then ready.

In the latter mode of watering, or that of catch-work, the principle confits in floating as much of the surface, as can be done, in the way most suited to the form of the grounds; taking care to prevent the water from sinking or flagrating; and collecting it again to be a second time, or more frequently thrown over new surfaces of the land. In order to put it in the power of the floater to receive the water, and to throw it again over some other portions of the ground, there must be a declivity sufficient for such purposes. A smaller quantity of water may be enough for watering, according to this method, than is necessary in flat flooding; and as the water is accommodated to the form of the ground, and no ridges required, the expense of watering in this way is generally very moderate, in comparison with that of floating flat meadows or lands. It is well adapted, too, to those gentle declivities which produce very little in the flate of nature, but may become highly valuable at little expense, when properly watered. On these and some other accounts, it would seem that all the preference to flat meadows or lands, that has been commonly claimed for them, is not due. At least, it admits of no question, that watering in catch-work, when properly executed, is a very beneficial and advantageous method.

The principal objection to this mode of watering is, perhaps, in the seeming unequal distribution of whatever nutrition the water may contain, which has certainly some weight in it; as the first surface over which the water passes, must of necessity have the advantage. It should not, however, be entirely forgot, that in most cafes of land in such declivities the confiderate farmer bellows most manure where the soil or land is the mofl thin and poor; and the water of catch-work meadows or lands does the fame; the higher situated grounds receiving it and its benefits the firft, and afterwards those which are lower, and, for the most part, richer, and deeper in point of earthy flake.

In this mode of watering, the feeders and drains are cut in a direction palling across the flope of the surface of the land; and having no greater fall, as the water flows in them, than to caufe it to move gently and freely, without either flagrating, or acquiring such a rapidity, as might endanger the works. In order to accomplish the work in this easy way, the water may be introduced at an upper corner, where it pails gently, and by a very small declivity in the feeder across the slope, and overflows the surface below its tract. A drain, at a proper distance below, receives the water, and transmits it into another feeder, cut on the fame plan as the former, where it again overflows, and is again taken up in a drain to be sent over new surfaces.

In this manner, a moderate quantity of water may float a fet of different spots lying in a diagonal direction, until it arrive at length at the bottom of the watered grounds, and reach a drain which carries it off completely. An entirely new fet of different spots may then be watered in the fame manner, the drains in the firft proceeds, or cafe, acting as feeders in the second, and the contrary in other cafes. But catch-work watering, so far as regards the method of per-forming it, admits of almost an endless variety. A conductor with stops may be formed, pointing directly down a declivity, if the rapidity of the current be not surpassed as dangerous for forcing up the channel in which it flows. From this conductor, feeders may be formed at right angles, to the right and to the left, or in either direction; and the stops in the conductor send the water into these feeders; which, being formed only a very little off the level, soon fill and overflow the grounds below them. The surplus water is collected in drains parallel to these feeders, which restore it to the conductor, whence it can again be diffused to right and left, in order to float a lower situated surface, from feeders constructed in the manner already seen.

There are many other ways of watering in different cafes of this nature; but where the lands are necessary to be laid down into permanent meadows, the works should evidently be substantially executed at once, and with proper care and design, whether the method be catch-work or flat meadows or grounds.

Regular plans of this mode of watering may be seen in the last editions of Wright's tract on the "Art of floating Land," and of Young's "Farmer's Calendar."

The writer of the work on "Landed Property" has given practical directions for four different methods of applying it artificially on the surfaces of grass lands, which may be useful in guiding the practice of the inexperienced.

1st. Flooding or covering low flat Lands with flagrant or float-moving Water.—This is a mode which, it is thought, was formerly, perhaps, the only one in use, in this country, for enriching the hales of valleys by the means of water. In the midland districts, tradition, it is said, speaks of it with familiarity. And the remains of works that have been used in practising it, are still evident. Even in the western districts of the southern range of chalk hills, which have long profited more by watering, than all the other districts of the island, this, it is more than probable, has been heretofore the only method in use. It is indeed an interesting fact, it is said, that the far-famed long-grafs mead of Orchelton, in the county of Wilts, is still watered in this manner. But it is conceived that there are now, however, few situations in which this method can be practised with the best effect. The one for which it is the most applicable is, it is supposed, a drained morass, or other flat moory ground, through which a stream naturally pails, or to which a sufficient supply of enriched waters can be led. A body of water, resting on a light fpongy surface, tends to comprefs and consolidate it; while the sediment of foul waters, let fall in palling from an agitated to a flagrant flate, further promotes this tendency. The rich moory meadows and pature grounds, which are seen in various parts of the kingdom, were doubtless, it is thought, brought to their present profitable flate, by being flooded with flagrant or float-moving waters.

Another, and perhaps the only other, fort or class of lands, to which this method can now be properly applied, is dry valley grounds, which are composed of a sufficient depth of soil for the pature of herbage, with a subfoil of flies, pebbles, or rough gravel, to draw off quickly the superabundant moiture that may be left in the soil, after its surface has been freed from water; and, thereby, to give vegetation the immediate freedom of action. But lands of this fort, having a sufficient command of water to flood them, are much less common, in this country, than those of the former clas or kind. The valley of Orchelton is, however, in itself, it is thought, a sufficient stimulant for searching narrowly for lands of fo valuable a formation, and which can command fertilizing water to flood them; as they may generally
nerally be watered at less expense by this, than by any other method.

The method of flooding flat or disheled lands artificially with standing water, is simply, it is said, that of raising a dam across the lower end of the site of improvement, of a sufficient height to overflow the land, and proper strength to sustain the weight of the water; with a channel at each end, to carry away the overflow; and with a valve in the middle of the lowest part to draw at pleasure.

Where the subfoil is not sufficiently absorbent and open to free the upper foil of superfluous moisture, preferably after the body of water has been drawn off, a main drain should be run up into the area of the site, and lateral ones be branched off from that, to wherever the water is found to hang; whether on the surface or in the subfoil. But where the subfoil throughout is retentive, though but in a small degree, the land may be considered as improper for this mode of watering, as will be seen below.

2d. Watering flat Lands with running Water, when raised into Ridges.—This is a method of practice which is conceived to be modern when compared with that of flooding, drowning, or covering the entire surface with standing water, as being a spirited mode which is still, as a general practice, confined to one part of the kingdom. Among the chalk-hills of Wiltshire and Dorsetshire, especially the former, there are large tracts of water-formed valley lands, which have long been watered with scientific accuracy and correctness. These lands, it is probable, were first brought to a firm state of sward, by flooding them, during a great length of time, with standing water; and have been since moulded into their present form; been raised into ridges, or other inequalities, in suitable manners, and properly watered.

It is proper and necessary, however, before to expensive a practice be recommended, to explain the principles on which it proceeds, and on which it may be profitably pursued and be recourse to; where suitable ground, and a sufficient supply of water, which is proper, can be employed. It is noticed that plants, as well as animals, have their natural elementary matters. That water plants, aquatics which root beneath the water, live but in this fluid, where they are enclosed, in a certain degree, from air and heat. On the contrary, the agricultural vegetables of this country, among which are to be reckoned the more nutritious meadow plants, require a free communication of atmospheric air and heat, to every part of them: they cannot live with their roots immerged in water, nor flourished while water is lodged immediately beneath them. And between these two opposite tribes of plants, is found an intermediate one, which is somewhat amphibious, or partakes something of the nature of both—the plants of which delight in water, yet can live, though not flourish, on dry land.—provided it be of a cool nature or quality.

It is stated that where the soil of low flat meadow lands of this nature, rests on a retentive bafe, the paludal marshy form of plants seldom fail to intermix with the meadow herbage. In a season which is favourable to dry land plants, the superaquatics are kept in a dwarfish underling state. On the contrary, in a wet season they flourish; while the better herbage becomes weak and unproductive. If, through neglect, the soil or land be suffered to remain saturated for any length of time with water, the meadow plants dwindle, or die, and the ranker wetland weeds take possession. Hence, in the practice of watering, the propriety of quickly relieving the soil or land from superfluous moisture or wetness, in order that the better herbage may gain the ascendency; especially in the spring, when a few days of warm weather the critical juncture may give the one the other a su-
buried under the ridges, while the furrows are left delitute. Where there is a great depth of fertile soil, the plough may be used with better effect than where the soil is shallow.

The next consideration is the elevation and convexity of these meadow ridges. On the principle offered, it is said, the steeper the sides are formed, the more beneficial will be the effect of the work. But it is not left certain that the expense of it will be proportionally great. Something may depend on the nature of the materials of which the ridges are to be formed, and the method of forming them. If, in moving the materials, a regular stratum of flints or gravel can be buried, at a proper depth, as an open subsoil, a small degree of elevation will be sufficient. In ordinary cafes, one foot of rise to sixteen feet and a half, or a statute-pole of bafe, will suffice; provided the drains between the beds be sunk to a sufficient depth. One foot of rise to five feet and a half of slope, or eleven of bafe, may be considered as the maximum of elevation in these cafes. On these premises, it is concluded, that a ridge set out one statute-porch in width at the bafe, requires an elevation of from nine to eighteen inches at the ridge; one of two perches in width, an elevation of from eighteen inches to three feet, according to the nature of the materials by which it is formed. In respect to the turn of surface, or form of the slope, there are sufficient reasons why it should be convex, not a regular inclined plane, nor of a concave or hollow caft. A regular sheet of water spread over a sloping surface has a natural tendency to break into streamlets, and to collect into partial currents. In the process of watering, this effect is produced in part, by the unevenness of the surface it is spread over, and the obstructions it meets with in its descent, as well as by the natural propensity of falling waters to collect into a body; and the steeper the descent, the greater freedom of action this propensity acquires. Hence, the propriety of giving the water a gentle descent on the upper part of the slope, in order to preserve the entirety of the sheet as far down the side of it as may be; and this is effected by the convex form, which also gives firmness to the sides of the trench. Besides, a convex surface, while it lefrens the descent at the ridge, increases it at the foot of the slope, and thereby hafens the drying in that part; to which the superfluous moisture of the entire slope tends, and where noxious plants are most liable to gain a footing; the earth or soil being there kept the longest in a state of saturation.

The width of these convex beds is a matter of much consideration. In what has been said of their elevation, it plainly appears that the expense of forming them is in proportion to their width. An acre of ground may be raised into beds of a rod wide, with the mentioned slope, at half the expense that another acre can be formed into three of two rods in width, and the same slope; the latter requiring to be raised at the ridge twice the height of the former; besides the work in this case being within a smaller compass. And from what has been faid of the form of the slope, it is equally clear, that water may be more evenly spread over a narrow than over a wide or deep slope; and that a narrow bed will dry more quickly than a wide one of the same soil and subfrata. Nevertheless, there is an advantage of wide ridges, which, in some situations, may more than over-balance all their inconveniences. A given quantity of water will float twice the quantity of ground, though perhaps not with twice the profit, when raised into beds of two poles wide, that it will in those of one perch in width, besides the current expenses of management being left. If, however, the quantity of water be great in proportion to the extent of ground, or if it can be collected again, and spread over other lands belonging to the same owner, which lie below those that have been watered, narrow ridges may claim a superioritv. Hence, the proper width of watered meadow ridges depends much on soil and situation, and on the quantity of water proportionate to the quantity of ground. In the neighbourhood of Stalisbury, the prevailing width, it is said, is ten yards, nearly two perches. In the vicinity of Amesbury, there are some of three times that breadth or width, but they are nearly flat. From one to three poles may fairly, it is thought, be set down as the ordinary limits of width.

In respect to the arrangement of these meadow beds, and the general economy of watered meadows or lands of this nature, almost every thing may be said to depend on the particular circumstances of the given site. But supposing a copious stream of good water to pass through a flat of water formed land, in a dilatation of the base of a valley; and supposing the situation of it to be nearly level from side to side of the same, or to have a gentle descent, the banks of the storm towards the outer margins; a cafe which often occurs when flat lands have long been liable to the overflow of foul waters. In this case, the beds require, it is said, to be run across the valley in a direct or oblique manner, as the descent may point out; and the water to be conducted to them by an artificial channel, winding on each side of the natural stream, with a main-drain near each outer margin, leaving room for a carriage-way between it and the foot of the bank of the valley; and where the grounds to be watered are wide, other road-ways may be left between the conducting trenches and the bed of the brook or rivulet. These dry slips of land are useful, not only in conveying away the crop, but in furnishing comfortable lodging-grounds for pasturing flock when the area of the land is moift. It follows, of course, that these road-slips should be watered with caution, late in the spring and during the summer months. The most eligible method of raising the water high enough to fill the trenches, is that of placing folding-gates, like those in use for navigable canals, across the stream, at the upper end of the ground to be improved. In summer, or when the water is not wanted for use, the gates may be thrown open, and fastened back, to give free passage to floods. But during the time of watering they are kept shut, to throw a confluent supply of water into the main trenches. If the descent downward of the valley be considerable, the main trenches or conducting channels require to have slips, or rather checks, placed across them, at distances proportioned to the descent, in order to fill with due effect the working trenches, the mouths of which open into the conducting channels; and, to gain more perfect command of the water, the mouth of each acting trench should be furnished with a regular valve, to admit just water enough to supply the given ridge while under watering, and to close the entrance effectually when it is laid. A lifting-board in the form of a shovel, with a short handle, and sliding in upright grooves made in the faces of two slender posts, joined together within the ground, becomes a simple and definable regulator for the purpose. And where a meadow ridge happens to be long and much declinating, a circumstance which should, as much as possible, be avoided: checks are likewise requisite to be placed in the working-trenches, to afflist in distributing the water evenly over its surface. These checks are formed in different ways. Two thick tough rods placed in the trench, so as to leave an opening between them narrow enough to force a sufficient quantity of water over the sides of the trench above them, and wide enough to let the remainder pass down freely into the lower part of the trench, form a ready and not ineligible check for this purpose; as the opening may be easily widened or narrowed.
rowed at pleasure. If the deficient straight across the valley be not sufficient, where the deficient down it is considerable, it is advised to direct the beds obliquely across it, and by this easy mean gain the required fall. But where the base of the valley is wide, so that the length of the beds, if run out from the natural stream to the outer bank, will be too great, as from fifty to a hundred yards, wind a conducting trench along the foot of the bank, as well as by the side of the brook or rivulet, and sink a deep drain in the midway between them. As to what regards the dimensions of working trenches, they should vary according to the breadths and lengths of the beds to be watered. The wider and deeper they are formed, the more freely a large body of water will pass along them. Hence it is evident, that the upper end of a long trench should have the larger dimensions; in order that a sufficient supply of water may pass freely to the further end, where the dimensions are required to be less; as the uniform contraction serves as a continual check to the water, and thus tends to force it in its passage over the sides of the trench. From fix to fifteen inches wide, and from four to ten inches deep, may serve to give a general idea, it is said, of their dimensions.

3d. Watering by spreading running Water over naturally uneven Surfaces.—In the more western counties of this country, but particularly in Devonshire, this practice has been established time immemorial. Even tradition there speaks not of its origin. The spring-waters that issue from the flate-rocks, which are there the prevalent substructure, are of a fertilizing nature; and the steep valleys that there abound are mostly covered with a rich deep soil, fit for hay-ground. Such circumstances will well serve, it is said, to account for the prevalence and antiquity of the practice in that part of the kingdom. Something of this practice, on a small scale, too, has been long in use in different parts of the country for spreading the overflows of dung-yards and pits, and the wash of home-flows over grass-lands lying below them. Of late years, also, it has been employed in different districts, in distributing the waters of more copious streams; and numerous instances still remain in which the practice may be extended with great and valuable effects.

If the quantity of water be small, whether it flow from a farm-dread, or a spring of superior quality, it should, it is said, be collected in a proper place, whenever it is not employed on the ground; more especially in the spring months, while the hay-crop is growing, in order to be able to liberate it, should its growth be arrested by a dry season, and to meliorate the soil as soon as the crop is off the ground for the benefit of the after-growth. The ground or situation of improvement is mostly given in the source of the water, or the point at which it can be commanded. Where this is a matter of choice, it is generally advisable to run the channel of supply along the brink or brow of a slope, as above: thus giving the flatter lands above it to the plough, to which in upland situations they are best suited, and the stepper to the fetyhe, as watered hay-grounds, for which they are the most eligible extending the ground downward to the foot of the slope, and to the flatter lands beneath it, provided their subsoil be absorbent and open, and the given quantity of water be sufficient for the whole extent. The canal or artificial water-courte from the natural stream or other source of the water, to the ground of improvement, requires a certain fall, to give a due degree of current to the water it may convey. If the motion of water in a supply-channel be sluggish, part of it is liable to sink, and be off by the way. Slowly moving water does not tend to make the bottom of the channel firm and water-tight, like a living stream: nor will a channel of the same size convey an equal quantity of water in the same time; nor will it clear itself so well from obstructions, as with a quicker current. On the contrary, dead water gives the suspended matter, which should be conveyed as nourishment to the plants, an opportunity of being deposited by the way in the form of mud, for want of agitation, and thereby fouling the channel. On the other hand, if the current be made too rapid, it is liable to wear the channel, and to cause unnecessary repairs. Besides, where all the height that can be properly got is required, every foot of superfluous fall contracts, unnecessarily, the field of improvement. On the grounds of practical experience, it is supposed, that one per cent, as one inch, foot, or yard of fall, in every hundred inches, feet, or yards of distance, is, in ordinary cases, the proper fall: this giving an active but inoffensive current. Under the above circumstances, and where the length of channel required is great, one-half per cent. may be made to suffice. Two-thirds of the ordinary fall gives a degree of life to the stream, and may, in many cases, be eligible and proper.

In setting out water-courses of this nature and sort, the use of the level is necessary; and the best forms of such courses, whatever the size may be, are those of inverted arches, as clearing themselves better when low in water, and giving firmer banks on the lower sides than is the case with square flat-bottomed steep-sided trenches. The modes of performing the work, and of laying them out properly, must be directed by the particular turn of the surface of the grounds.

In the low lands which lie at the feet of the sloping grounds, the natural surfaces of which are sufficiently uneven to admit of running water being spread over them, without the assistance of art; and the subfrastra of which are sufficiently absorbent and open, to permit them to dry quickly, after the water is taken off: the method of watering, where they lie pretty regularly shelving, is to lead the water along the higher side of the land, and to draw it off by a main-drain on the lower side; straight working trenches and corresponding drains being cut, downward of the area, so as to spread the water over the whole, without suffering it to lodge on any part of the surface. This is that which may be distinguished by the Devonshire practice, or manner of watering.

Where, however, the surface is more irregular, lying in natural swells and ridges, with dips and hollows between them, the water is to be led along the tops of such higher parts, without regard to the straightness or regularity of the trenches; and the drains to wind up the hollows and lowest ground with the same irregularity. There are two ways of ascertaining the true lines of the trenches and drains in cases of this nature. The one is by flooding the entire area, where it can be done, and driving down levelling-pags over every part of it, so as to leave their heads uniformly level with the surface of the water; which being let off, the shortt pegs shew the proper lines for the trenches, the longs the line of the drains. This method was used by Bakewell, in Leicestershire. The other, which has occurred in the writer's experience, is attended, it is said, with less trouble and inconvenience. The higher parts are readily ascertained, and the lines of the trenches accurately traced by a proper levelling implement; artificial mounds being raised between the detached knolls when wanted. After the fresh-made ground has properly settled, and the trenches have been duly formed, the water is turned on; and by this ready means, the proper lines of the drains are accurately given. This is a safe way of watering valley lands; and

Vol. XXXVIII.
where the irregularities of surface are sufficiently great, and
the subsoil absorbent, it is very eligible; especially, if in
making the trenches and drains, the turf and soil so raised
be applied in adjusting the natural defects of the surface.

In the watering of more deeply sloping grounds, as the
fides of hills, and the lower banks of valleys, in what may be
termed the Devonshire practice, as having been long there
and thereabouts chiefly established; as there, the fides of
the valleys hang or nearly in their natural flates; many of
them appear as if they had never been subjected to the
plough; and those which have been in tillage, have been
laid down again to grafs with nearly their natural surfaces.
The practice of laying up foils into high arable ridges, has
never, perhaps, gained a footing in that part of the king-
dom. In these cafes, the conducting channel being led along
the brink, and across the upper part of the slope, as
advised, the working trenches are to be supplied from it by
means of checks and valleys, as already seen. The differences
between the working trenches are to be regulated by the
steepnesses and unevenness of the surface. Wherever the fleet
of water is seen to break, and to divide into numerous
streamlets, there a trench is required to catch and reprop
it; the working trenches, in this manner of watering,
acting in the two-fold capacity of trenches and drains:
frelish supplies of water being let down from above, to the
lower trenches, as occasion may require.

Where the depth or downward length of the flope is
great, or where an additional supply of water offers itself,
and where reservoirs are formed at different heights, an addi-
tional main-channel is required, to lead a fresh supply across
the midpoint of the slope. This main-trench likewise re-
ceives the waft water from above; and, like the working
trenches, acts at once as a supplying-channel, and as a
accepter of the waft water: hence, a given quantity of
water will float a much larger extent of ground in this man-
er of watering, than in watering ridges, raifed on level
ground; though, it may be preumed, not with equal
benefit.

In forming the trenches of whichever fort, the turf and
loose earth that are raised out of them, and which are not
wanted to make their lower fides firm and level, are to be
used in filling up the channels and dimples that naturally
happen in the face of the slope; in order that the water
may spread more evenly over it, and thereby to lessen the
requisite number of trenches. To the fame end, if hillocks
or small protuberances occur, as they generally do on nat-
ural surfaces, they are to be lowered by turning back the
surf, using their contents as above, and returning the fods to
smoothed surfaces. But, where the knoll is large, water
may be led by a narrow branching trench to its top, and be
thus spread evenly over its fides. The proper defcent or
decline of the working trenches depends, in some measure,
on the precision of water that enters them. One quarter per
cent. may serve as a guide in fetting them out: first making
them of inferior dimensons, and then turning on the water:
afterwards enlarging them, and in doing this, adjusting
them in such a manner, that the water will flow evenly out
of them, from end to end. The shorter the acting trenches
are made, the more easily they may be regulated without the
incumbrance of checks, which should be avoided as much as
possible.

4th. Watering sloping Grounds that have been raiied into
Ridges by Cultivation, and as in the State of Grass.—In
watering ridges on slopes, or fuch shelving grounds as have
formerly been in a state of aration, in which they have been
raised into high wide convex beds, resembling those ad-
vised above, for flat meadowy surfaces, and have been laid
down to grass in that form; a practice which, it is suppos-
ed, has been common to many parts of the kingdom, especi-
ally where the common-field system prevailed; the direc-
tion of the ridges being mostly directly downward of the flope.
In this cafe, it would be in vain to attempt to spread water
over the surface, in the manner usually practifed on more
even slopes. And if it be thrown into open trenches, cut
along the tops of the ridges, agreeably to the practive in
use for level grounds, and according to the ordinary prac-
tice of watering the lands now under confeferation, the
operation becomes very imperfect. For, if the defcent be
considerable, the water will unavoidably flow out of the trenches
in streams immediately above the checks; and the fides of the
ridges will consequently be wafered partially. These dif-
ficulties in spreading water evenly over ridges on steeply
shelving surfaces, have led some induftrious managers to
throw down the ridges, and return the waters to their natural
flates. But this, where the ridges are high and wide, is
very troublesome and expensive if done by hand; and if
performed by the plough, is greatly injurious and hurtful
to the land for many years. A better method has there-
fore been had recourse to by the writer. Instead of leading
the water down the ridges, it is thrown into the furrows,
and spread over the fides of the beds by means of crooked
trenches, wifding, in the feetoon manner, horizontally, or
nearly so, across them, and led more effentially on their tops
by pointed trenchetts depending from the deftoumed parts.
These waving trenches, like thofe equity plain
sloping surfaces, act both as feeding-trenches and as drains,
or collecting trenches, to reprop the water evenly over the
ground, immediately below them: thus keeping the entire
ridge covered with a flleet of brilfly moving water.

When the upper ends of the ridges are sufficiently wafer
watered, the water is to be let down the furrows to the parts below;
or if the ridges are short, their whole length may be
watered at once, by letting the water partially down the
furrows to the lower parts, by the means of cuts of proper
widths, made with a sharp tool across the lower fides of the
trenches, where they cross the furrows: these few regu-
ators acting as checks in the common modes of watering.
The differences between the trenches, as well as their form,
must always vary with the steepness of the flope or defcent,
and the shape of the ridge.

Considerable tracts of land in North Wales have been
watered in somewhat this manner of late years.

In concluding, it may be flated on the best authority,
that the beneficial practice of waftering, by fome of the
methods which have been fuggelted above, may be greatly ex-
tended and applied in different parts of the country where it
has yet been but little tried, as on the fenny lands of the
conties of Lincoln, Norfolk, Cambridge, Northampton,
and, perhaps, fome others, where it is particularly defirable,
as well as the bottoms of the chalk-hills in different dif-
tricts, as Yorkifh and Suffolk, and the vales of Hertford-
shire, the chalky parts of Buckinghamshire, Oxifhire,
and Suffolk, which are peculiarly fitted for the purpofe;
befides many others where good waters are afforded for making
fuch improvements on grafs-lands.
of garden-watering, and under the heads of the different plants, as they may require it; but the nature of its application, in these cases, may be explained in the present place

For plants in these situations, Mr. Fordyce has advised the use of simple water only, in clearing them from different nuisances to which they are exposed. Though lime-water in other cases may be more powerful and have a better effect, as will be seen below. It is directed to be applied in this manner. About four o'clock in the afternoon a barrow-engine is to be filled with soft water, or such as has been exposed to the sun through the day, and wheeled along the foot-paths of the houses, where they are wide enough to receive it, and the whole of the plants sprinkled with the liquid, by pressing the finger on the top of the pipe of the engine, in order to spread the water somewhat in the manner of a fine shower of rain, playing the engine and throwing the fluid likewise against the top-lights and shelves of the houses, until the water stands an inch deep in the paths of the houses. A small copper engine may be made use of, and answers very well, when a barrow-engine cannot get into the houses. It may be had in most places. But if an engine should not be conveniently at hand, which can be got into the houses, the front-lights may be opened, or, where there are no front-lights, the top-lights may be flided down, and the water be thrown in at the fronts or tops. When this operation is begun, if in the night, every light must be close shut down; and if the water be thrown in at the fronts or tops, one light only is to be kept open, which is immediately to be flut, when that part of the house, which is opposite to it, is sufficiently watered; then proceeding to open others until the whole be properly watered. The houses after this are to be kept close until the next morning; which will cause such an exhalation from the glass of the houses, and the beds that may be in them, if there should be any, that the plants will, it is said, be covered all over with steams or vapour; which will infaillibly destroy and clear them of the vermin and other hurtful matters that may be upon them, especially those of the plant-loupe and cucocus kinds. This fort of watering is, however, to be repeated every afternoon, in the time of hot weather only. By it a great deal of labour in watering will be saved; but such plants as stand in need of much watering, should have the water given them before the sprinkling of the houses is begun. In most cases, the plants will have imbibed all the moisture before morning, and the paths of the houses will be perfectly dry.

As it sometimes happens that in hard winters, when strong firs are under the necessity of being kept in the floves or other houses night and day, that the plants which stand on shelves in those of the dry kind, are so parched up, that the leaves drop off, as from deciduous trees in the autumnal season, which renders them very disagreeable in their appearance; it should be prevented or remedied by watering, in the manner directed below by the same writer. About eight or nine o'clock in the morning, when the sun shines out, and there is the appearance of a fine day, water is to be thrown into the houses until the floors are covered to the depth of nearly two inches; they being kept shut the whole day, unless the heat rises very high, which is seldom the case at such a season of the year, but when it does happen, the doors may be opened to admit a little air. By the middle of the day, the water becomes entirely exhaled, and the floors quite dry. The operation may be repeated two or three times in a week in rainy weather. The plants in the course of a week's time begin to recover, or throw out new foliage, and in a fortnight or three weeks become in full leaf again, displaying themselves in a fine manner.

This fort of watering is greatly useful on many other occasions, as in the growth of plants in the pits of such houses.

Fruit-trees in such houses may also be watered in the same manner with much benefit in some cases; but for those against walls, a lime-water prepared by putting thirty-two gallons of soft water to half a peck of unslaked lime is recommended to be used in this manner. With the clear liquid, after the lime has subdued, the engine is to be filled, and a good watering given to the trees, throwing a considerable part of it forcibly under the leaves, and spreading it finely by the means directed above; at the same time, wheeling it backwards and forwards, that no parts of the trees may be missed. This should be performed when the weather is cloudy, or when the sun is off the wall that contains the trees. Where the trees are on an open wall, the watering may be begun about half past eleven o'clock; if on a north wall, the watering may be done the first thing in the morning; and when they are on a south wall, it may be executed about four o'clock in the afternoon; it is to be repeated once a day for six or seven days in succession. If, however, there should be cold northerly or easterly winds, or frosty nights, such watering should be discontinued until the weather becomes more mild and temperate. Care is constantly necessary that the trees get dry before night, and that no watering takes place while the sun is upon them. Care is likewise to be taken not to water them with any of the grounds of the limy liquid, which would injure the leaves, and make the trees look very unightly.

This fort of watering, with the use of lime and wood-ash, diffused to the under-sides of the leaves, are found extremely effectual in destroying and clearing away every thing noxious about the trees, and in rendering them healthy and productive. See Watering, in Gardening.

Watering-Pots, Pans, or Cans, are such contrivances of this nature as are fitted for pouring water over feeds, plants, trees, &c. in pots or otherways in a fine shower divided into small spaces, these being provided with strainers or roes of a finer or coarser kind for the purpose, well adapted to their respective uses. They are particularly convenient for potted plants of all sorts, as well as many other kinds. They form the principal mode of hand-watering.

Watering Sheep, in Agriculture, the supply them with water. This is particularly necessary in the management of flocks in some situations, as on the South Downs; and there is there no other water than what is to be collected by some artificial method, ponds are constructed for retaining such water as falls in rain; these, for this use, are commonly made circular, and very gently sloping to the centre; the bed very strongly rammed down to prevent any loss by foaming through the chalk. As ponds are liable to become leaky, and to be spoilt by a hard frost, they are made by lining them with chalk, puddled and trod down until it makes a fort of platter floor. If a little good stone lime was sifted evenly over the whole and trod well in with the chalk, it would probably effect the uniformity of rendering them perfectly retentive of the water under all circumstances.

In Italy the sheep-flocks were regularly watered morning and evening, as is evident from Columella, and the practice has probably considerable utility, especially in dry situations.

Watering-Syringe, in Gardening, a large kind of garden syringe employed for throwing water to some height over trees or plants, in a forcible manner, in the way of a stream, for clearing away insects and other matters, as well as some other purposes.
WATERING the Soil of Tillage Land, in Agriculture, the practice of improving ploughed ground, and the crops upon it, by the application of water.

The outlines of a plan for watering arable or tillage crops and lands, that has long been familiar to the writer on the Management of Land, are first to form the soil into flat beds or ridges, with intervals, or trenches, directed somewhat obliquely across the slope, or general descent of the field or ground; namely, so as to dip from one quarter to one half per cent. on the dead level; this declination being equally calculated to communicate and carry off water. The width of the beds is to be regulated by the nature of the land. Absorbent soils may be laid into wider beds than those which are repellant, or of the stiff heavy kind, that are less prone to draw away the water.

The depth of the trenches should vary according to the quality of the water, and the intention of using it. For merely moistening the land, in a dry season, with ordinary water, the trenches, it is conceived, should be deep, so as to lodge the water in the subsoil, rather than the soil above it. But when an enriched water is to be used to fertilize the soil, and encourage the growth of the crop during its early stages, it requires to be communicated immediately to the surface of the plants; consequently, in this case, the beds should be narrow, and the trenches no deeper than just to prevent the water from overflowing.

When the water is necessary for, and conducted into the uppermost corner of the field or open ground, to be continued and conducted down the slope across the higher ends of the beds, and to be forced into the trenches, by the means of regulated checks, placed below their mouths, as occasion may require; it should be either suffered to run with moderate streams along the trenches; or, if the quantity be small in proportion to the extent of ground, it may be checked at proper distances, so that the whole of it shall be absorbed, thus going over the ground, and repeating the watering as the quantity of water, or the sufficiency of moisture may direct.

WATERING, in the Manufactory. To water a fluff is to give it a fluff by wetting it lightly, and then paffing it through the press, or the calender, whether hot or cold. See TABBING.

WATERLAND, DANIEL, D.D., in Biography, was born in 1683, at Wafely, in Lincolnshire, where his father was rector, and sent to Magdalen College, Cambridge, in 1699, for the completion of his education; from this college he was elected a fellow in 1704, took his degree of M.A. in 1706, and became a private tutor. His treat, entitled “Advice to a young Student, with a Method of Study for four Years,” published at this time, was popular, and passed through several editions. In 1713 he was nominated master of his college, and presented to the rectory of Ellingham in Norfolk. On occasion of taking his degree of B.D. in 1714, he distinguished himself by defending before the regius professor of divinity the negative of his thesis, “Whether Arian subscription be lawful?” Being chosen chaplain in ordinary to King George I., he was nominated, on his majesty’s visit to Cambridge, D.D., and incorporated in the same degree at Oxford. Distinguished as a champion of orthodoxy by his “Vindication of Christ’s Divinity, being a Defence of some Queries relating to Dr. Clarke’s Scheme of the Holy Trinity,” printed in 1719, he was appointed in the following year the first preacher of lady Moyser’s lectures in favour of the divinity of Christ. He also published an answer to Dr. Whitby on the same subject, and in 1721 he was presented by the dean and chapter of St. Paul’s with the rectory of St. Alphna in St. Faith. His “History of the Athenaeum Creed,” vindicating it against the objections of Dr. Clarke, was published in 1723, and his prefaces to the canony of Windsor, the vicarage of Twickenham, and the archdeaconry of Middlesex, kept pace with his publications of this nature. His remarks on Dr. Clarke’s “Exposition of the Church Catechism,” printed in 1750, engaged him in a controversy with Dr. Sykes on the sacrament of the Lord’s supper. Against Tindal’s “Christianity as old as the Creation,” he published his “Scripture Vindicated,” and his “Christianity Vindicated against Infidelity.” On these treatises, Dr. Middleton published remarks, and they were defended by Dr. Zachary Pearce. In 1754 Dr. Waterland made an attempt for refuting Dr. Clarke’s opinions in a “Discourse of the Argument a priori for proving the Existence of a First Cause,” and in this year, having declined the office of preacher of the lower house of convocation to which he was chosen, he published his treatise “On the Importance of the Doctrine of the Trinity,” which he regarded as fundamental, avowing his high respect for the authority of the fathers in this and other articles of faith. In 1756 he commenced a series of archdiocesan charges on the subject of the eucharist, arguing against the opinion of Hoadley on the one hand, that it was a mere communicative feast, and against that of Johnson and Brett, on the other, that it was a proper propitiatory sacrifice. But a complaint under which he laboured, and which required repeated governmental operations, endured by him with exemplary patience, at length terminated his life in December 1746, in the 58th year of his age. A collection of his sermons was published after his death. “As a controversialist,” says one of his biographers, “though firm and unyielding, he is accounted fair and candid, free from bitterness, and actuated by no percuting spirit.” Gen. Biog.
fellow, supported by the feet at Amsterdam, for the instruction of their youth in the various branches of philosophy, and sacred erudition. One of these Waterlandian feats was divided, in 1664, into two factions, of which the one were called Galenists, and the other Apostolians, from their respective leaders. Mosheim’s Eccl. Hist. vol. iv. vol. v.

WATERLOO, Anthony, in Biography, a Flemish landscapes painter of great abilities, is generally supposed to have been born at Utrecht, about the year 1618; it is certain that he resided there the greater part of his life, and the scenery of his pictures is found in the environs of that city.

His landscapes are characterized by the greatest simplicity of composition; the entrance into a forest, a broken road with a bank and a few trunks of trees, a solitary cottage, a mill, &c. are made interesting by the exquisite touch, and beautiful colour and chiaro oscuro, with which he treated them. His skies are clear, and his clouds float in air; his colouring, however, is sometimes too strongly contrasted with yellow foregrounds and blue distances, and offend the eye for want of being more broken. He marked the characters of his trees admirably, in form and colour. His pictures are by no means common, as they are not numerous. He occupied himself very much in etching his own designs and views, and his productions in that art are as valuable as his pictures, in point of truth and skill; and will always continue to be a source of pleasure and improvement to the artist and the connoisseur.

His plates, according to Bartch, amount in number to 150, not entirely completed with the point, but finished with the graver, to soften and to invigorate them. It is to be lamented that he funk an early prey to habits of intemperance.

WATERLOO, in Geography, a village of the Netherlands, between 12 and 13 miles from Brussles, situated behind the skirts of the fine beech forest of Soignies, rendered famous by one of the most severe and fanguinary battles which modern history of war records, fought in its vicinity on Sunday the 18th of June, 1815, between the duke of Wellington, who commanded the British, Hanoverian, German, and Belgic army, and Napoleon Bonaparte, who conducted the operations of the French forces. The ground on which the battle was fought is said not to exceed two miles from north to south, including the whole from the rear of the British to the rear of the French position; and from east to west, from the extremity of the left to that of the right wing of the contending armies, is about a mile and a half in extent; so that the fanguinary result of the battle has been attributed in some degree to the confined space in which they were engaged, and the consequent intermixture of the two armies. The position of the French troops is represented as the best, because the eminence occupied by them was higher, and the ascent steeper than ours, and better adapted to attack and defence. The village of Waterloo, which is not seen from the field of battle, was occupied on the Saturday night previous to the battle by the duke of Wellington, the principal officers of his staff, the prince of Orange, lord Uxbridge, sir Thomas Picton, sir William de Lancey, and other general officers. The French army in the Netherlands, is said to have amounted to 130,000; and after the losses of the 15th and 16th, and the detachment of two corps under Marshal Grouchy, there must have remained at least 90,000 men, with which Napoleon took the field on the 18th of June; while, after allowing for the losses of the allies on the 16th, which were very serious, it must appear that there was a great disparity in regard to numbers; as it may be deduced from a statement, founded upon the latest return to the Horse Guards, previous to the battles of the 15th and 16th, that the extreme force British and German was 45,221 men, under the duke of Wellington, to which we may add 22,000 for Brunswick and Dutch, so that the whole could not exceed 68,221 men; or, as it is elsewhere stated, there could not be in action a greater number than 64,000 men to support the attack of the whole French army. From the adjutant general’s office, 6th November 1816, it appears that the effective strength of the British army, present at the battle of Waterloo on the 18th of June 1815, was 74,430, including the army of observation. It is moreover observed, that the hostile army consisted of the main troops of France; that it was a regular and disciplined army, even before the Bourbon’s quitted France, and that from the return of Buonaparte every thing had been done to render it effective; it was indeed the force which had been selected and combined to act upon the northern frontier. Whereas the allied army, the British part excepted, was almost wholly a green army; the allies, particularly the Dutch, Belgians, Hanoverians, and troops of Nassau, being chiefly young soldiers.

Previously to the grand and decisive battle of Waterloo, the campaign had commenced on the 15th of June by an attack upon the outposts of the Prussian army, commanded by field-marshall prince Blucher. The points of concentration of the several corps of his army were, Fleurus, Namur, Ancy, and Hannut. Buonaparte advanced the second corps of his army by Thuni, along the banks of the Sambre, upon the town of Charleroi, and drove the advanced parties of general Ziehen’s corps back upon the bridge of Marchienne. After a very smart action, the Prussian general was obliged to retire behind the river, and collect his corps near Fleurus: and as he considered Charleroi untenable, the troops stationed in that town were withdrawn, and the French cavalry entered it about mid-day. The Prussians defended their advanced posts with bravery; and it was only the overwhelming force that was brought against Ziehen’s corps, which induced that general to withdraw his advance, in order that he might concentrate his whole force near Fleurus.

On the evening of this day an officer arrived at Brussles from marshal Blucher, to announce that hostilities had commenced. The duke of Wellington received his dispatches, whilst he was sitting after dinner with a party of officers. The troops were ordered to hold themselves in readiness, to march at a minute’s notice. Before midnight a second officer arrived from Blucher, and the dispatches were delivered to the duke of Wellington in the ball-room of the duchess of Richmond; and he gave his orders to one of his staff-officers, who instantly left the room. In the midst of the repose that seemed to reign over Brussles, the drums suddenly beaten to arms, and the loud call of the trumpet was heard from every part of the city. The whole town became instantly anuniversal show of bustle. The soldiers assembled with their knapsacks, and every kind of warlike preparation threw the town into a state of agitation. But before eight in the morning, the streets, which had been filled with busy crowds, were empty and silent; the great square of the Place Royale, which had been filled with armed men, and with all the appurtenances of war, was now quite deserted. The duke of Wellington had set off in great spirits, observing, that as Blucher had most probably settled the business, he should perhaps return to dinner.

When the direction by which Buonaparte intended to penetrate into Belgium had been ascertained, the duke of Wellington immediately gave orders for the army under his command
command to concentrate on the extreme of its position, near the great road from Brussels to Charleroi, and in a line between Nivelles and Namur. The fifth division of the British army, with the corps of the duke of Brunswick-Oels, left Brussels about 2 A.M. on the 16th, and advanced towards the position where the whole army was ordered to assemble.

One brigade of the Dutch troops, which was in advance towards Charleroi, had been attacked, when the Prussians fell back on the 15th, and driven from its advanced position near Franes; but the prince of Orange having moved up another brigade of the same army, they were able to repulse the enemy, and in the evening they regained the greater part of the ground which had been lost throughout the day.

On the morning of the 16th, Prince Blücher, who was determined to meet Buonaparte with all his strength, had pohted the army under his command on the heights between the villages of Brie and Sombref, and to some distance beyond Sombref. In front of this line, he occupied the villages of St. Amand and Ligny with a very considerable force.

Buonaparte, as soon as he had passed the Sambre, directed the great body of his force against the Prussian line. Marshal Ney, who commanded the left wing, was directed to advance by Gollinc and Franes, and attack the British position; his force consisting of the first and second corps of infantry, and four divisions of cavalry.

The third, fourth, and fifth corps, with the guard in reserve, were ordered to attack the Prussian position in front, while the fifth corps under Grouchy, and a division of cavalry, were detached towards Sombref, on the Namur road, with the view of manœuvring on that flank.

On debouching from Fleurus, Buonaparte had an opportunity of reconnoitring the position of marshal Blücher with more precision. He immediately placed the first corps belonging to the left wing under Ney, with two divisions of heavy cavalry, behind the village of Franes, on the right, and at a little distance from the Brussels road, where it was to form a reserve, that could be brought up to support either his attack upon the Prussians, or Ney's attack upon the British. The third corps was ordered to advance in column to carry the village of St. Amand, while the fourth corps, supported by the guard and the cavalry, was ordered to attack Ligny.

The enemy advanced in overpowering masses upon St. Amand, where the action first commenced on the morning of the 16th. The brave Prussians defended this part of their advanced position with great firmness, and it was not till after a long and sanguinary conflict, that they were obliged to yield for a time to superior numbers. The fourth corps commenced its attack upon the village of Ligny about mid-day, and by one o'clock P.M. the action may be said to have become general throughout the whole of the extended line of the allied British and Prussian armies. Grouchy by that time had attacked the extreme left beyond Sombref, and Ney had come in contact with the advance of the army under the duke of Wellington, near Franes. But it was in the villages of St. Amand and Ligny, that the greatest struggle for victory took place, between the contending armies. There the battle continued for five hours, it may be said, almost in the villages themselves, as the movements forwards and backwards, during that period, were confined to a very narrow space. Fresh troops were constantly moved up on both sides; and as each army had immense masses of infantry behind that part of the village which it occupied, these served to maintain the combat, as they were continually receiving reinforcements from the rear. Upwards of 200 pieces of cannon were directed against the villages, and they were frequently on fire in many places.

About 4 o'clock, Prince Blücher placed himself at the head of a battalion of infantry, and charged with them into the village of St. Amand. After a dreadful struggle, he gained possession of the greater part of it. The enemy were panic-struck, and the victory seemed so doubtful, that Buonaparte was obliged to send in all haste for the first corps, which he had left in reserve near Franes; at the very moment too, that it had become equally necessary to marshal Ney, whose columns, having been repulsed by the fifth division of British infantry, were retiring in great confusion.

The advantage which Blücher had so nobly gained, was of little importance to the general action in which his troops were engaged. At Ligny, the battle still raged with unabated vigour; and though the evening was far advanced, the victory remained undecided. The badness of the roads, and the difficulties which general Bulow had to encounter in his march, prevented his corps from getting up on the 16th; so that Blücher had only three corps of his army in position; and though they had repulsed every attack which had been made upon them, the danger was becoming urgent, as all the divisions were engaged, or had already been so, and there was no reserve at hand.

As the night advanced, the enemy, favoured by the darkness, made a circuit round the village of Ligny, with a division of infantry on one side, and, without being observed, got into the rear of the main body of the Prussian army, at the same moment that some regiments of cuirassiers forced their passage on the other side of the village. This movement decided the day, and field-marshall Blücher was obliged to commence his retreat; yet his brave columns, though surprised, were not dismayed. They formed themselves into fold masses, and, repulsing every attack which the enemy made upon them, retired in perfect order to their original ground, upon the heights above the village, and from thence continued, un molested, their retrograde movement upon Wavre.

This movement of the marshal's rendered necessary a corresponding one on the part of the duke of Wellington; and he retired from the farm of Quatre Bras upon Genappe, and thence upon Waterloo, the next morning of the 17th at 10 o'clock.

The duke of Wellington, having given orders for the army under his command to concentrate on the left, proceeded with the fifth division and the duke of Brunswick-Oels' corps, in the direction of Charleroi. About two o'clock on the afternoon of the 16th, the head of the British column reached the farm of Quatre Bras, so named from its standing near where the roads from Brussels to Charleroi, and from Nivelles to Namur, cross each other. The advance of the enemy under Ney, who had again driven the Dutch troops from their position near Franes, had nearly reached the same spot; and general Kempt's brigade had scarcely time to deploy from the great road, before it was attacked by the enemy's cavalry, supported by heavy masses of his infantry. Nothing could exceed the daring intrepidity of the French troops at this moment; their leaps on the 15th, and confidence in their leader, added to the natural bravery of the troops, made them advance with almost a certainty of victory. The sudden appearance of overwhelming masses of cavalry, and the rapidity with which they charged our infantry, before they had time to throw themselves into squares, created some little confusion in one or two regiments. Indeed, so daring were the French
French cuirassiers, that a regiment actually cut into the
square of the forty-second Highlanders; but they paid
dear for their temerity, as few ever returned to their lines;
and the Highlanders had ample revenge for the loss of their
brave colonel Sir Robert Macara. The third battalion of
the Royal Scots, twenty-eighth, and first battalion of the
ninety-fifth, were warmly engaged for several hours on the
left of the Brussels road; while general Pack's brigade,
confining the forty-four, seventy-ninth, and ninety-
fifth regiments, with the forty-second already mentioned,
succeeded completely in compelling the enemy on the right,
and the equally arduous contest.

About 4 o'clock, the first division under major-general
Cooke, and third under lieutenant-general Sir Charles Alan,
were engaged in the same line of action, and the enemy's
right, with a great degree of vigour, was vigorously pressed
by the two battalions of the forty-second led by the
colonel, and the second battalion of the ninety-fifth led by
his lieutenants. The French infantry, however, had been
more than an hour in action; and the men, having been
exposed to the severe heat of the day, were much
enfeebled. The officers of the forty-second, notwithstanding
this disadvantage, continued to lead their men with great
bravery and decision, and the officers of the ninety-fifth
were equally conspicuous in their exertions. The French
infantry, however, had been more than an hour in action;
and the men, having been exposed to the severe heat of the
day, were much enfeebled. The officers of the forty-second,
notwithstanding this disadvantage, continued to lead their
men with great bravery and decision, and the officers of the
ninety-fifth were equally conspicuous in their exertions.

Waterloo. Wellington slept at a small public house in the village of
Waterloo.

As soon as day-light appeared on the morning of the
18th, the British army could perceive, from its position,
immenent masses of the enemy moving in every direction,
and before two o'clock the whole of his force appeared to
be collected on the heights and in the ravines, which ran
parallel with the British position.

The French army, when concentrated in front of the
position of the allies, consisted of four corps of infantry
including the guard, and three corps of cavalry, the whole
number of men being uncertain, and probably overrated by
those who figured them at 120,000.

At 11 o'clock everything seemed to indicate that the
awful contest would soon commence;--a contest in which
victory was obstinately and valiantly disputed on both sides,
but which at last terminated in the complete triumph of
the Duke of Wellington, and total defeat and political
annihilation of Buonaparte. The weather had cleared up, and
the sun shone a little as the battle began, and the armies within
300 yards of each other, the Duke of Wellington, with his
usual quickness, had soon perceived the nature of the attacks
that would be made upon his line; and when the troops
flood to their arms in the morning, he gave orders that they
should be formed into squares of half battalions, and in that
state await the enemy's attack.

Marshal Ney, as soon as Buonaparte's order was
communicated to him, directed the division of infantry
commanded by General Buonaparte, to advance upon Hougou-
mont; and about half past eleven o'clock, the first columns
of this division made their appearance upon the ravine, or
rather hollow ground, which leads down from the public-
house of La Belle Alliance, to the Chateau. The two
brigades of artillery belonging to General Cooke's division
had taken up a position on the ridge of the hill in front of
the line of infantry, and the moment the enemy made his
appearance, our nine-pounders opened upon his columns.
The artillery officers had got the range fairly accurately,
that almost every shot and shell fell in the very centre of his
masses; so great was the effect produced by these few guns,
that all Jerome's bravery could not make his fellows advance,
and in a moment they were again hid by the rising ground
from under cover of which they had but just emerged.
This, which was the commencement of the action, was
considered a very favourable omen by our brave fellows
who witnessed it; and for a short time they were much amused
with the manœuvres of Jerome's division, and the cautious
manner in which it seemed to emerge from its hiding-place.

This state of things, however, did not continue long,
as other great movements were observed to be preparing
throughout the enemy's line. A powerful artillery was
brought to bear upon our guns that had so annoyed his first
advance, and general Jerome's troops gained the outskirts
of the wood, where they became engaged with our light
troops. By mid-day the cannonade was general.

The great object of Buonaparte, in this important battle,
was evidently to force our centre, and at the same time turn
our right flank; so that by surrounding and taking Pri-
soners, as it were, one half of our line, he might completely
paralyse and destroy the effect of the other half. Un-
fortunately, our centre was the weakest part of our position,
and upon that part he directed his first grand attack to be
made about noon.

An immense mass of infantry, followed by a column of
upwards of twelve thousand cavalry, advanced upon the
points occupied by the third and fifth divisions, and the left
of
of the Guards, covered by a fire from upwards of one hundred pieces of artillery. These columns, which seemed to advance with a certainty of success, were led by count d’Erlon in person. They advanced almost to the muzzle of our muskets; but here they soon found they had Britons to contend with; our fellows gave them a volley; and, cheering, rushed on to the charge, which they did not fland to receive, and our cavalry emerging from the hollow ground where they had hitherto been concealed from the enemy’s view, passed through the openings between the squares, and charging the enemy’s cavalry, succeeded completely in dispersing them, and driving them back upon their own line.

In this conflict, which was dreadful while it lasted, the enemy was baffled in all his attempts, and, besides the killed and wounded, lost several thousand prisoners and an eagle; but the British army had also to lament the loss of its brightest ornaments, and his majesty, one of his best officers. The gallant sir Thomas Picton fell, mortally wounded, in leading on the fifth division.

About 3 o’clock, when Buonaparte found that Jerome’s division could not drive the guards from Hougomont, he ordered the chateau to be set on fire. The shells from several mortars which were brought to bear upon the houses, soon had the desired effect: but our troops, retiring into the garden, did not yield one inch of their ground; and the only thing which the enemy gained by this cruel measure, was the destruction of a few of our wounded, who were too ill to be removed, and who fell a prey to the flames. The troops in La Haye Sainte, having expended their ammunition, were obliged to retire for a moment from that point, and the enemy got possession of the house and garden; but as soon as a reinforcement of our troops could be moved up, he was driven from that as well as from every other point which he had attacked: and at no period during the day, notwithstanding the heavy masses of infantry and cavalry which were advanced against our centre, time after time, was he ever able to force our position; and the possession of the advanced post of La Haye Sainte for a few minutes, may be said to have been the greatest advantage he ever gained. The battle continued to rage with unabated fury, and the number of brave men who were continually falling on both sides was very great, while the rapidity with which the columns of attack succeeded each other, seemed to indicate for a time, that the resources of the enemy were inexhaustible. The artillery on both sides was well served: but Buonaparte had upwards of two hundred and fifty pieces in the field; while the train of the allied army under the duke of Wellington did not exceed one hundred guns, nine-pounders and six-pounders. Notwithstanding our inferiority in this arm, which was still more apparent from the size of the enemy’s guns (being twelve-pounders) than from their numbers, ours were so well fought, that it is allowed by all, they did equal execution.

About 2 o’clock, the duke of Wellington dispatched an officer of his staff to the head-quarters of field-marshall Blucher, to ascertain his movements, and to know when it was probable his advance would come in contact with the enemy. This officer found the Prussian general at the village of Laines, where he gained the information required. At half past 7 o’clock, the issue of the battle was still doubtful. The greater part of lord Hill’s corps of the British army had been moved up different periods to the support of the first column. The whole of Bulow’s corps and part of the second corps of the Prussian army, had arrived at their position near Frictermont, and their attack in that direction was sufficiently powerful to oblige the enemy to give way on his right; which Buonaparte having observed, conceived that the moment was now arrived when he must put an end to the engagement. He informed his generals that the firing on the right was occasioned by the arrival of Grouchy’s corps. This gave fresh hope to his troops already beginning to despair, and immediately he gave orders to form the left column of attack. This column was composed principally of the guard, which had hitherto suffered but little; he gave directions for the whole of the line to second this effort, upon which he said the victory depended, and placing himself at their head, they advanced in double quick time.

These veteran warriors, so long esteemed the first troops in Europe, advanced across the plain which divided the two armies, with a firmness which nothing could exceed; and though our grape and canister shot made dreadful havoc in their ranks, they were never disconcerted for a single moment. Our infantry remained firm in their position, until the enemy’s front line was nearly in contact with them, when, with the usual salute of a well-directed volley, and a British cheer, they rushed on to the charge with bayonets. This charge even the Imperial guard could not withstand, and those undaunted troops, who at one time considered themselves the conquerors of the world, were obliged to give way. In this attack the British and French guards were, for the first time, perhaps, fairly opposed to each other. The shock for a moment was dreadful. The enemy refused to take or give quarter, and the carnage was horrible. At last the whole of their ranks was broken, all discipline was at an end, and they began to give way in the utmost confusion. The duke of Wellington, who was on the spot, was not inattentive to the manner in which the enemy retired from this attack, and, though his left was still pressed, he ordered the whole line of infantry, supported by the cavalry and artillery, to advance. This order was no sooner given, than our brave fellows rushed forward from every point. In a moment they carried the enemy’s position, and obliged him to retire in great disorder, leaving in our possession a number of prisoners, and upwards of one hundred and fifty pieces of cannon, with their ammunition, besides two eagles. Before the disorganized masses of the French had cleared the ravine by which they retired, the right and left of the British line were nearly in contact, and the enemy in a manner surrounded. What added greatly to the confusion of the beaten foe, was a gallant charge by general Ziethen’s corps upon his right flank, at the moment the British advanced in front. Blucher, who had joined with his first corps at the time this decisive charge was going on, advanced with his gallant troops; and about nine o’clock the two field-marshals met at the small public-house called La Belle Alliance, and mutually saluted each other as victors.

The British army, which had been so warmly engaged for upwards of nine hours, was now halted, and the pursuit left to the brave Prussians. Though they had already marched many leagues, all fatigue was forgotten when in the presence of their enemy. About half-past nine field-marshall Blucher assembléd the whole of his superior officers, and gave orders for them to send every man and horse in pursuit. It is not easy to ascertain the number of those who were killed and wounded from the 15th to the 18th days of June inclusively. The loss of the guards, in killed and wounded, in the defence of Hougomont, amounted to 28 officers, and about 800 rank and file. The foreign corps (Nassau and Brunswickers) lost about 100. Within half an hour, it is said, 1500 men were killed in the small orchard of
of about four acres at Hougomont. The loss of the French was enormous. The division of general Foy alone fell about 3000, and their total loss in the attack of this position is estimated at 10,000 in killed and wounded. Above 6000 men of both armies perished in the farm of Hougomont; 600 French fell in the attack on the chateau and the farm; 200 English were killed in the wood; 25 in the garden; 1100 in the orchard and meadow; 400 near the farmer’s garden; 2000 of both parties behind the great orchard. The bodies of 300 English are buried opposite the gate of the chateau; those of 600 French have been burnt at the same place. The wounded at Quatre Bras, 16th of June, are stated upon the report of the adjutant-general, to be 5000; but no estimate is given of the killed, who must have been very numerous. On occasion of Blucher’s retiring to Halle, he is said to have had 14,000 men killed and wounded. The loss of the British, as stated in a letter dated June 15th, since the 16th, must have exceeded 5000. In the battle of Ligny and Quatre Bras, Napoleon is said to have lost 10,000 men. The total of the killed and wounded of the British soldiers, as returned from the War-office July 1815, amounts to 6755 persons. The total of the killed, wounded, and missing of the royal artillery in the battles of the 16th and 18th of June 1815, comprehends 32 officers, 15 serjeants, 285 rank and file, and 529 horses. The loss of the Dutch in killed, wounded, and missing, is stated to be 4156. The Prussians are said to have lost 33,150.

According to the French accounts their loss, at the battle of Fleurus on the 15th, was 10 killed and 80 wounded, and that of their enemy 2000, of whom 1000 were prisoners. The loss of the Prussians on the 16th could not be less, as they say, than 15,000 men, and their own 3000 killed and wounded. At Quatre Bras they say, that the English lost from 4 to 5000 men; and that theirs, which was very considerable, amounted to 4200 killed and wounded. They make no statement of that of the 18th.

The total loss of the British, Hanoverians, and German legions from official reports, from June 16th to the 26th, 1815, is 11,084; and the computed losses of the Dutch and Prussians during the campaigns in the Netherlands were, that of the Dutch as above stated 4156, and that of the total Prussian loss 33,150.

It appears from the list of killed and wounded from the official returns, June 16 to June 26, 1815, that an immense number of officers, several of whom were high in rank, is included in one or other of these classes. In the former, are the names of the duke of Brunswick-Oels, colonel Cameron, lieutenant-colonel Canning, lieutenant-colonel sir F. d’Oly, colonel sir H. W. Ellis, lieutenant-colonel sir A. Gordon, colonel sir W. de Lancey, and colonel sir R. Macara, lieutenant-general sir T. Picton, major-general sir W. Ponsonby, &c. &c.; and in the latter we find the prince of Orange, the earl of Uxbridge, colonel Hon. A. Abercromby, lieutenant-general sir C. Atten, major-general sir E. Barnes, major Beckwith, lieutenant sir H. Berkeley, lieutenant-colonel sir H. Bradford, major Cameron, lieutenant-colonel Cameron, lieutenant-colonel R. H. Cooke, colonel sir J. Ellay, captain Hon. E. S. Erskine, lieutenant-colonel sir R. C. Hill, lieutenant-colonel Macdonald, colonel Hon. F. Ponsonby, lieutenant-colonel Fitzroy Somerset, earl of Uxbridge, &c. &c.

After the most diligent research, amidst confused and contradictory accounts, it is difficult, if not impossible, to ascertain the exact number of the killed and wounded, on both sides, in this fangourous and decisive conflict.

Honourable and prosperous as was the issue of this battle, we cannot forbear regretting that so many valuable lives should be sacrificed on occasions of this kind, and we also lament the condition of those who are wounded and maimed, and rendered helpless for the residue of their years. We applaud the spirit that has actuated such multitudes, and disposed them to confer honour on the name and memories, or to impart to the succour and supply, of those who have fallen or suffered in the service of their country.

The singular importance of this victory, the pre-eminence of talents of the commander-in-chief, and the heroism displayed by the officers, commissioned and non-commissioned, and by all the privates, on this interesting occasion, entitled them to the gratitude of the government and of the country, and to such tokens of respect as were thought to be most appropriate to the occasion. Accordingly, it was resolved on the 23rd of June, that the thanks of both houses of parliament should be given to his grace the duke of Wellington, prince Blucher, and the allied armies, officers and soldiers. The prince regent also granted the dignity of a marquis to earl Uxbridge and his heirs. The house of commons agreed on June 29th 1815, in an address to the prince regent, requesting him to direct a national monument to be erected in honour of the splendid victory of Waterloo, and to commemorate the fame of the officers and men of the British army, who fell gloriously upon the 16th and 18th of the said month; and more particularly of lieutenant-general sir Thomas Picton, and major-general the Hon. sir William Ponsonby; and that funeral monuments be also erected in memory of each of these two officers in the cathedral church of St. Paul, London. The prince regent has also been pleased, in the name and on behalf of his majesty, to grant promotion to 52 majors, recommended for brevet-rank, for their conduct in the battle of Waterloo, to be lieutenant-colonels in the army; and to 36 captains to be majors, with commissions respectively, dated from June 18, 1815. His royal highness has also appointed major-general sir James Kempt, to be knight grand cross of the most honourable military order of the Bath; and major-generals G. Cooke, Maitland, and F. Adam, to be knights commanders of the said order, and a number of other officers to be companions of the most honourable military order of the Bath, upon the recommendation of the duke of Wellington. The king of the Netherlands has given the duke of Wellington the title of prince of Waterloo, and the states-general have settled upon his family an estate annually producing 20,000 Dutch florins, (2000l.) consisting of woods, &c. in the neighbourhood of La Belle Alliance, Hougomont, &c. The king of Saxony has also conferred upon the duke his family order of “The Crown of Rue;” and the grand duke of Baden has conferred upon him his order of “Fidelity” of the first class, accompanied with a gold festoon-box, enriched with diamonds of great value. The emperor of Austria has conferred upon him a number of officers the cross of a commander, and of a knight respectively of the order of “Maria Theresa.” The emperor of Russia has also conferred decorations of different classes of the orders of St. George, Anne, and Damien, on a number of officers. The king of the Low Countries has also conferred decorations of different classes of the “Wilhelm’s” order upon certain officers. The king of Bavaria has conferred decorations of different classes of the order of “Maximilian Joseph,” on certain officers; all these in testimony of their respective approbation of their services and conduct. The prince regent has granted the dignity of a baron of the United kingdom of Great Britain and Ireland unto the right honourable lieutenant-general Rowland baron Hill and to his heirs; and in token of his high approbation of the distinguished bravery
and good conduct of the first and second line-guards at the battle of Waterloo, he has declared himself colonel in chief of both these regiments. He also declares that he shall approve all the British regiments of cavalry and infantry which were engaged in the battle of Waterloo, being permitted to wear on their colours and appointments, in addition to all other badges and devices, the word "Waterloo," in commemoration of their distinguished services on the 18th of June 1815; and he also approves all the ensigns of the three regiments of foot-guards having the rank of lieutenants, and that such rank shall be attached to all the future appointments to ensignies in the foot-guards, in the same manner as the lieutenants of those regiments obtain the rank of captain; and he also approves of the first regiment of foot-guards being a regiment of grenadiers, and styled "The First or Grenadier Regiment of Foot-Guards."

An alteration has also taken place in regard to the pensions allowed to wounded officers in favour of those who have served in the battle of Waterloo; and it is also ordered that henceforth every non-commissioned officer, trumpeter, drummer, and private man, who served in the battle of Waterloo, or in any of the actions which immediately preceded it, shall be borne upon the muster-rolls and pay-lists of their respective corps as "Waterloo Men," and that every "Waterloo Man" shall be allowed to count two years' service in virtue of that victory, in reckoning his services for increase of pay, or for pension when discharged.

It is also ordered, that the lieutenants of cavalry and infantry, who had served more than five years as such, on the 18th of June 1815, or who may subsequently have completed that period of service, are to receive one shilling per diem for every day's service as lieutenant beyond five years, it being fully understood that the retrospective is, in no instance, to exceed two years. In like manner, the corporals and privates, distinguished as "Waterloo Men," are to receive the benefit of the two years' service retrospectively, in cafes in which, by the addition of the two years, they would have completed their respective terms of service, on or previously to the 18th of June 1815, and the two years' service will, of course, be reckoned in all claims subsequently accruing.

Sir Charles Alten is honoured with the title of count, and the Hanoverian troops, who were present in the battle, may bear on their colours and uniform the word "Waterloo." Other regiments also that are particularly specified, are to have the word "Waterloo" in commemoration of their distinguished services, June 18th, 1815. The prince regent has commanded, that in commemoration of the brilliant and decisive victory of Waterloo, a medal shall be conferred upon every officer, non-commissioned officer, and soldier of the British army, present upon that memorable occasion. It is also appointed, that from the date of the battle of Waterloo, 18th June 1815, the pensions to officers and widows shall increase according to the officer's further advance.

It is a farther instruction with regard to the Waterloo grant, that lieutenants of cavalry and infantry, who had served more than five years on the 18th of June, are to receive one shilling per day for every day beyond five years' service, provided the retrospective be not beyond two years: non-commissioned officers and privates are also to benefit proportionately from the same retrospective. The charge for officers is to be made in their ordinary accounts; those for men distinctly in a pay list supplementary, according to a prescribed form.

Prize-money was also granted by parliament to the army which served under the command of field-marshals his grace the duke of Wellington in the battle of Waterloo and cap-

**WATERLOO.**

This was advertised in the London Gazette, June 21, 1817. Those shares that have not been claimed before the 24th of September 1817, may afterwards be received from the deputy treasurer of Chelsea hospital, if claimed within the period of six years.

The shares of each individual in the following classes are:

<table>
<thead>
<tr>
<th>Class</th>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Officers</td>
<td>£61,000</td>
</tr>
<tr>
<td>2</td>
<td>Field officers and colonels</td>
<td>1,724</td>
</tr>
<tr>
<td>3</td>
<td>Captains</td>
<td>90</td>
</tr>
<tr>
<td>4</td>
<td>Subalterns</td>
<td>34</td>
</tr>
<tr>
<td>5</td>
<td>Serjeants</td>
<td>19</td>
</tr>
<tr>
<td>6</td>
<td>Corporals, drummers, and privates</td>
<td>21</td>
</tr>
</tbody>
</table>

Notice has also been given in the Dutch, Flanders, and German papers, that his highness the prince of Waterloo, duke of Wellington, has given orders for the payment of the prize-money to all the allied troops, who fought under his command at Quatre Bras and Waterloo, at the taking of Paris.

His highness has fixed the proportions into classes as above. This distribution includes the Dutch, Belgic, Nassau, Hanoverian, and Brunswick troops.

The total amount of receipts for the Waterloo subscription to May 31, 1817, has been 518,288l. 9s. 11d. The total expenditure for payments and donations, and incidental charges, leaves a balance at the bankers 18th of June 1817 of 1,222l. 13s. 5d.

Statement of the appropriation is as follows:

- **Annuities granted for Life.**
  - To the widows of officers, non-commissioned officers, and privates killed: £9,594
  - To the wounded non-commissioned officers, and privates totally disabled: £1,649
  - To dependent relatives: £540

- **Amount of annuities for life:** £11,783

- **Annuities granted for limited Periods.**
  - To the children of officers, non-commissioned officers, and privates: £8,314
  - To orphans: £895

- **Amount of annuities for limited periods:** £9,209

- **Total amount of annuities:** £20,992

**Voted in Money.**

- To the wounded officers, non-commissioned officers, and privates: £71,126
  - To the parents and dependent relatives of officers, non-commissioned officers, and privates killed: £28,577

- **To the Foreign Troops, viz.**
  - Prussians, Brunswickers: £45,000
  - Hanoverians, and Netherlands: £17,500

- **Additional for the exclusive benefit of their orphans rendered such by the campaign of 1815:** £62,500

- **Total amount voted in money:** £162,203

A considerable subscription, amounting to 39,057l. 14s. gd. received
received from Demerary, has been lately announced,
February 24, 1818.

On the second anniversary of the battle of Waterloo, the
noble structure of the bridge over the Thames from Surrey
to the site of the Savoy, was first opened for public ac-
commodation; and with a view of commemorating the ever-
memorable victory of Waterloo, its name was changed from
that of the "Strand Bridge," to the more dignified and
triumphal appellation of "Waterloo Bridge." The cere-
mony was conducted with great dignity and splendour.

This bridge exhibits a very striking display of the eminent
abilities and taste of Mr. Rennie, the engineer, as well as of
the liberality of the proprietors, who have provided the
funds necessary for its construction. Its situation is judi-
ciously selected, as, independently of the advantage which
commerce and the convenience of personal intercourse may
derive from it, it gives the grandest view we have of the
river in its beautiful meander, displays the rising crescent of
buildings on the north side, and brings out Somerset Terrace
in the most favourable way; while on the south it opens
the beautiful prospect of the Surrey hills.

The following are some detailed particulars of the bridge,
which is constructed of Cornish granite; the balustrades are
of granite from Aberdeen.

**Dimensions of the Bridge.**

<table>
<thead>
<tr>
<th>Description</th>
<th>Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length of the stone bridge within the abutments</td>
<td>1,242</td>
</tr>
<tr>
<td>Length of the road supported on brick arches on the Surrey side of the river</td>
<td>1,250</td>
</tr>
<tr>
<td>Length of the road supported on brick arches on the London side</td>
<td>400</td>
</tr>
<tr>
<td>Total length from the Strand, where the building begins, to the point in Lambeth where it falls to the level of the road</td>
<td>2,592</td>
</tr>
<tr>
<td>Width of the bridge within the balustrades</td>
<td>42</td>
</tr>
<tr>
<td>Width of pavement or foot-way on each side</td>
<td>7</td>
</tr>
<tr>
<td>Width of road for horses and carriages</td>
<td>28</td>
</tr>
<tr>
<td>Span of each arch</td>
<td>120</td>
</tr>
<tr>
<td>Thickness of each pier</td>
<td>23</td>
</tr>
<tr>
<td>Clear water-way under the nine arches, which are equal, 120 ft. each</td>
<td>1,080</td>
</tr>
<tr>
<td>Ditto on the London side</td>
<td>40</td>
</tr>
<tr>
<td>Ditto the water-course</td>
<td>16</td>
</tr>
<tr>
<td>Granite ditto for the water-course</td>
<td>9</td>
</tr>
<tr>
<td>Total number of arches from the Strand to the Lambeth level</td>
<td>65</td>
</tr>
</tbody>
</table>

In building the arches, the stones (some of which weigh
upwards of six tons) were so accurately jointed and care-
fully laid, that upon the removal of the centres, none of the
arches sunk more than an inch and a half. In short the ex-
cellency of the workmanship vies with the beauty of the
design, and with the skill and arrangement, to render the
"Bridge of Waterloo" a monument of the public spirit,
taste, and glory of the age, of which the metropolis, and the
British empire, have abundant reason to be proud.

We shall close our account of the battle of Waterloo,
with stating a fact not unworthy of being recorded. The
rates-general desiring to give to his royal highness the prince
of Orange a testimony of the national gratitude, for the
bravery which he employed, as well in the defence of the
possession of Quatre Bras as at the battle of Waterloo, have
proposed to his majesty, to purchase at the expense of the
State a palace, situated in the city of Brussels, which, after
being properly furnished, may be given in full property to
his royal highness the hereditary prince, as well as the park
of Toweuren, in the forest of Sogingé, with a hunting-let;
and that these estates be transferred to the prince of Orange,
free of all charges and expense. His majesty approved of
this proposal. See Battle of Waterloo, &c. 2 vols. 8vo.
London, 1817.

**WATERMEN** are such as row in boats, or ply on the
river Thames, ultimately subject to the direction and go-
vernment of the lord-mayor of London, and court of alder-
men, who settle their fares, and, as well as other justices of
peace, have authority to hear and determine offences, &c.

The names of watermen are to be registered; and their
boats must be twelve feet and a half broad, and four and a
half broad, or be liable to forfeiture; and watermen, taking
more than the fares aforesaid, shall forfeit 40s., and suffer half
a year's imprisonment; and refusing to carry persons for
their fare, shall be imprisoned for twelve months. None
shall ply on the river, but such as have been apprentices to
watermen for seven years. 2 & 3 P. & M. cap. 16.

The lightermen and watermen constitute a company;
and the lord-mayor and aldermen yearly elect eight of the
latter, and three of the former, to be rulers, and the water-
men choose assistants; the rulers and assistants being em-
powered to make rules, which are required to be observed,
under penalties. The rulers on their court-days shall ap-
point forty watermen to ply on Sundays, for carrying
passengers across the river, who pay them for their labour,
and apply the overplus to the poor decayed watermen; and
those persons are allowed to travel on a Sunday with boats,
unless they are licensed and allowed by a justice, on pain of
forfeiting 5l. 11 & 12 W. III. cap. 21.

No apprentice shall take upon him the care of a boat, till
he is sixteen years of age, if a waterman's son, and seven-
eteen, if a landman's, unless he hath worked with some able
waterman for two years, under the penalty of 10s.; and if
any person, not having served seven years to a waterman,
&c. row any boat in the river Thames for hire, he shall
forfeit 10l., gardeners' boats, dung-boats, fishermen's,
wood-lighters, western barges, &c. excepted. No appren-
tice is to be taken under fourteen years, who shall be bound
for seven years, and inrolled in the book of the watermen's
company, on pain of 2l. No tilt-boat, row-barge, &c. shall
make more than thirty-seven passengers, and three more by
the way; nor any other boat above eight, and two by the
way, on forfeiture of 5l. for the first offence, and 10l. for
the second, &c. And in case any person be drowned, where
a greater number is taken in, the waterman shall be deemed
guilty of felony, and transported. 10 Geo. II. cap. 31.

Tilt-boats used between London-bridge and Gravesend
shall be fifteen tons, and the other boats three tons. Rules
of the watermen's company are required to appoint two
officers, one at Billingsgate at high-water, and another at
Gravesend, to ring a bell for the tilt-boats, &c. to put
off; and those which do not immediately proceed with two
sufficient men, shall forfeit 5l. The fares of watermen,
aforementioned, which are, from London-bridge to Lime-
house, Ratcliffe-cross, &c. for oars 1s., and scullers
6s.; Wapping-dock, Rotherhithe-church stairs, &c. for
oars 6s., and for scullers 3g.; from either side of the
water above the bridge to Lambeth and Vauxhall, for oars
1s., and scullers 6s. For all the stairs between London-
bride and Westminster, oars 6s., and scullers 3g.

**WATERS** among **Farriers**, the name given to a dif-
temperature of horses. See **WATERY SORCER**.

**WATERSAY**, in **Geography**, one of the Western
islands of Scotland, about one mile south of South-Uist,
from which it is separated by a channel, called "Chifamul
Bay." This island is about three miles long, and one
broad. N. lat. 56° 54'. W. long. 9° 30'.
WATERTIGHT STUFF denotes clay, or any other tenacious and compact soil, which will hold water.

WATERTOWN, in Geography, a town of Massachusetts, in the county of Middlesex, containing 1531 inhabitants; 7 miles W.N.W. of Boston.—Also, a town of Connecticut, in the county of Litchfield, containing 1714 inhabitants; 26 miles N.N.W. of New Haven.

WATERTOWN, a post-township of New York, the capital of Jefferson county, and a place of deposit for the military stores of the state of New York. It lies near the mouth of the Black river, about 80 miles N.W. of Utica, and was first created into a town in March 1810, from a part of Mexico, then in Oneida county, and comprised also Rutland and Hounsfield. Its extent is about six miles square. The inhabitants are principally emigrants from the eastern states. Here are about 200 dwelling-houses, eight school-houses, a court-house and gaol, together with a lodge and arsenal for military stores. Here are also eight grist and saw-mills, one paper-mill, one wool-carding machine, five distilleries, two breweries, a printing-office and weekly paper, a small air-furnace, and many common mechanics. It promises to be a place of much business. Pot and pearl ashes are manufactured in abundance, and sent in boats to Montreal. By the census of 1810, the population consists of 1849 persons; and here are 308 senatorial electors.

WATERTOWN, or Jefferson Village, is a flourishing post-village of Watertown, in Jefferson county, on the south bank of Black river, four miles from Brownville, and at the same distance from navigable water communicating with Lake Ontario. The village contains about 50 dwelling-houses, some of which are elegant. In its vicinity are a quarry of good building lime-stone, clay, and sand. Pine and other timber are plentiful.

WATERVILLE, a town of the district of Maine, and county of Kennebec, containing 1314 inhabitants.

WATERVIEN, a large township of New York, in the north-east corner of Albany county, 6 miles N. of Albany; extending 10 miles along the Mohawk, and 61 miles along the Hudson, and having an area of about 52 square miles, exclusive of several islands in the Hudson. Much of the land is poor and barren, and the population is very unequally distributed. Along the Hudson are some fine flats, and in many places the river-hills are moderately steep, and afford good farming lands. The interior abounds with sandy ridges, some marshes, and wet land, wooded with pine and a variety of shrubbery, of little value. In this township are two small villages, viz. Washington, five miles north of Albany, and Gibbon's Ville, opposite Troy, six miles. The Cahoes, which are the principal falls of the Mohawk, are between Watervie and Halfmoon, in Saratoga county. The whole river Mohawk descends in one sheet at high water, about 70 feet; and below the falls the spreading branches form islands, which are attached to this town; there are Haver island, Van Schaick's island or Cahoes island, and Green island. In this town are 1092 white males, 1070 white females, 128 slaves, and 75 other persons; in all 2365; and 215 senatorial electors. The settlement of the people called "Shakers" lies in the north-west part of this town, at a place called Niskayuna, 8 miles N.W. of Albany. They have a house of worship, and the village contains about 150 houses. A manufactory of iron screws has lately been erected on the Mohawk, near Cahoes bridge.

WATERVIEN, a town of Flanders; 12 miles E. of Sluys.

WATER HEAD. See HYDROCEPHALUS.

WATER Humour. See AQUOUS and HUMOUR.

WATER Lands, in Agriculture, all such as are largely impregnated with and retentive of moisture or wetness.

Wherever water rests much upon lands, it fours them, and destroys the finer herbage; the remaining plants being made to become coarse and strong, but mostly unpalatable, and of little value for stock. They should, of course, have the superabundant water removed from them, and then be improved by suitable substanres applied as manures, and by other means, such as being flooded, in some cases.

By such methods, according to the nature of their wetness, such lands may most be brought into a good state of improvement. See Bog, Fen, Morass, Marsh, and Swamp; also the lands of their several natures.

WATER Pate, a name sometimes given to a difeafec in sheep, from their having a sort of poke or bag hanging below the top of their throats, supposed to be caused by water. See Sheep and Rot.

WATER Source, difeases of the legs and patterns of horfes and some other animals, in which there are watery within and fores, which discharge an acid watery fluid. They mostly arise from bad feeding, and improper management in dressing and the use of exercise.

The cure will commonly be effected by giving strengthening remedies, with calomel and squills in moderate doses, and by the gradual use of elatic bandages to the parts.

WATFORD, in Geography, a market-town in the hundred of Calhio, and county of Hertford, England, is 8 miles S.E. from St. Albans, 20 miles W.S.W. from the county-town, and 14 miles N.W. from London. Previous to the Conquest, Watford formed part of Calhio, and under that appellation was given by King Offa to the abbey of St. Albans, to which it continued attached till the time of the disolution, when the stewardship of this and other adjacent manors was given to John, lord Ruffell. James 1., in the seventh year of his reign, granted Watford to the lord chancellor Eger- ton, in whole descendants, the dukes of Bridgewater, it remained vefted till about the year 1760, when it was pur- chased by the then earl of E inflict, and is now the property of the present earl. The town consists principally of one street; the houses being ranged on the siles of the high road, and extending in a north-westely direction rather more than a mile. The buildings are chiefly of brick, and many of them very respectable. The police is under the direction of the resident and neighbouring magistrates. A market, which is now held on Tuesdays, was granted to the abbots of St. Albans's for Watford by Henry I.; and Edward IV. gave them liberty to hold two annual fairs, which are now increased to four. The market-house is a long building, rough-cast above, and supported on wooden pillars beneath. Corn is sold here in very large quantities; and the number of cattle, sheep, calves, and logs, is proportionable. Employment for the labouring classes is chiefly derived from agriculture; but an additional source is furnished by the throwing of filk, three filk mills having been established in or near the town. The parish of Watford comprehends, with the town, the hamlets of Calhio, Levedon, and Ox- hey. In the population return in the year 1811, the number of inhabitants was stated to be 3976, occupying 766 houses. The church, a very spacious edifice, consists of a nave, three aisles, and a chancel; with a massive embattled tower at the west end, about 80 feet high. The church contains several fine monuments, among which are two by Nicholas Stone. At the south side of the church-yard is a free-school, founded and endowed in the year 1704, by Mrs. Elizabeth Fuller, for the education and clothing of forty boys and twenty girls; the government is vested in nine trustees, chosen out of the principal inhabitants of the town. Here are also eight almshouses, for the maintenance of so many poor widows.

About
About one mile north-west of the town is Gafbiury, the seat of the Earl of Essex. The manor is a spacious edifice, situated in an extensive and well-wooded park, through which flows the river Gade; and to which is the line of the Grand Junction Canal. The house was originally begun in the time of Henry VIII. by Richard Morison, Esq., and completed in the style of that age by his son, Sir Charles Morison. It has since been greatly altered and improved, particularly under the direction of the present noble owner, and contains a number of elegant apartments, together with a kind of cloister, the windows of which have been recently ornamented with painted glass, executed in a very superior style. In its general appearance, the whole mansion, with its offices, has the character of a monastic dwelling. The rooms are adorned with numerous portraits, and other pictures of the first degree of merit. The park is between three and four miles in circumference, and affords rich scenery and noble timber; the pleasure-gardens and gardens are extensive, and have lately undergone some judicious alterations. A particular description of this splendid feat, by Mr. Britton, is contained in Havell's "Views of Gentlemen's Seats," &c. which also contains a print of it.-Salmon's History of Hertfordshire, vol. 1728.


WATH, in Rural Economy, a term often used provincially to signify a ford.

WATHUL, in Geography, a town in Sweden, in the province of Smaland; 47 miles W.N.W. of Wexio.

WATKINS'S Point, a cape on the S.W. coast of Maryland, in the Cheapeake. N. lat. 37° 59'. W. long. 76°.

WATLING'S Island, one of the Bahama islands, about 18 miles long, and 4 broad. N. lat. 23° 50'. W. long. 74° 16'.

WATLING-STREET, in Roman Antiquity. See Way.

WATLINGTON, in Geography, a small market-town in the hundred of Pirton, and county of Oxford, England, is situated between the two high roads leading from London to Oxford, about half a mile N. by W. from the Ikenhead-street, at the distance of 5 miles S. from Tetworth, 15 miles S.E. from Oxford, and 46 miles W. by N. from London. The streets are narrow, and the houses, with a few exceptions, mean and ill built. There is no staple manufacture of any consequence; the making of lace, however, prevails to some extent, and forms the chief employment of the labouring females. A school has been formed expressly for the purpose of teaching this art, and is usually attended by from forty to fifty pupils. The town is watered on the south side by a brook, rising in the vicinity, which now works, within two miles from its source, four corn-mills. A weekly market is held on Saturdays, which was originally granted to Roger Bigod, Lord of Norfolk, in the reign of Richard I. But this market is thinly attended; and the busses of the day are invariably conducted in the parlours of the principal inn. Here are likewise two annual fairs. In the centre of the town is the market-house, a substantial building, erected by Thomas Stonor, Esq., in the year 1664; he also founded and endowed a grammar-school for ten boys; according to the will of the donor, the master was to be a graduate of one of the universities; but imperious circumstances have caused this article to be dispensed with: four boys have been added to the original number, and the whole are taught in a commodious room above the market-house, in which are likewise held the courts leet and baron of the manor. The magnificence hold a petty sessions once in a fortnight during the winter, but in summer not so often. According to the population return of the year 1811, this town then contained 239 houses, the number of inhabitants being 1150, which was a decrease of 156, since the enumeration of the year 1801. The church is a respectable ancient building, situated N.W. of the town: in the chancel are several neat monuments, and a handsome burial-place of the Horne family. Lands and tenements have been left by will for the repairs of the church, without any parish-rate for that purpose; and there have also been considerable sums bequeathed for the use of the poor. Previous to the Reformation, the abbots and canons of Osney were patrons, to whom the church was appropriated in 1263, by the bishop of Lincoln. In this parish is anciently a chapel, founded by the lord of the manor of Watcomb; but on a complaint made by the abbots and canons of Osney, pope Urban III. dissolved it: no traces can now be discovered of the site occupied by this structure.

Welsh Methodists and Baptists have each a place of worship in the town; but the number of these societies is comparatively small. The Methodists were established here during the life of John Wesley, who occasionally preached in the open street: a substantial meeting-house has lately been erected, but not more than thirty persons are in the habit of attending. The Baptists are scarcely so numerous; and their meetings are held in a very humble building. The manor of Watlington was given by Henry III. in 1231, to his brother Richard, Earl of Cornwall. By Edward II. it was granted to Piers Gavendon. On his disgrace he reverted to the crown, and was given by Edward III. to Sir Nicholas De la Beke, who obtained permission, in 1338, to build a spacious castle, some traces of which were discernible within the last century. The building stood on a slightly elevated spot to the south-east of the church, and it may yet be perceived that the structure was encompassed by a moat. King Charles I. granted the manor, in 1628, to four citizens of London, who held it in the following year. Soon after this period it became so divided and parcelled out, that in the year 1664 there were about fifty persons participating in the manorial rights; and previous to the enclosure of the parish, which took place in 1809, the shares of the manor were sixty-four in number.

On Britwell-hill, about a quarter of a mile east of the Ikenhead-street, some remains of trenches point out the site of an ancient encampment.

Within half a mile from Watlington is one of the most complete agricultural establishments to be found in the county. The whole of the very extensive farm-yard is encompassed by buildings covered with slate, and presents the spectacle of a new and handsome village. This noble range was erected under the immediate inspection of William Hayward, Esq., and was completed in the space of one year. His principal object appears to have been to produce utility on the simplest and most scientific plan.

About a mile to the north of Watlington is Pirton, an inconsiderable village, though it gives name to the hundred. Near Pirton is Shirhaourjerre, the seat of the Earl of Macclesfield. A cæsculated edifice was first erected on this spot in the fourteenth century by Sir Warner de l'isle. The castle and manor were purchased at the beginning of the eighteenth century by Thomas, Earl of Macclesfield. The building forms an oblong square, and is encompassed by a broad and deep moat, over which are three draw-bridges; the chief entrance is guarded by a portcullis: at each angle of the edifice is a circular tower. The interior is disposed in a style of modern elegance and comfort that contains no allusion to the external character of the structure, except in one long room, fitted up in a bower, and containing coats of mail, shields, tilting-spears, and offensive arms of a modern as well as ancient date. A park of about sixty acres is attached.

WATO, a town of Sweden, on an island in the Baltic, near the coast of the province of Upland; 10 miles E.S.E. of Nortelge. N. lat. 59° 54'. E. long. 18° 45'.

WATOLMA, a town of Sweden, in the province of Upland; 10 miles N. of Upland.

WATRAN, a town of Hindoostan, in Madura; 33 miles S.W. of Madura.

WATSCH, or Vatsche, a town of the duchy of Carniola; 16 miles S.E. of Stein.

WATNESS, a cape on the west coast of the island of Shetland. N. lat. 62° 19'. W. long. 2° 6'.

WATSON, Robert, D.D., in Biography, a Scottish historian, was born at St. Andrews's about the year 1730, commenced his course of education for the ministry at the school and university of St. Andrew's, and with singular affinity prosecuted his studies at the university of Glasgow, and also in that of Edinburgh. He paid particular attention to grammar and eloquence, and with the advice of lord Kames, delivered a course of lectures on these subjects, which gained the approbation of Mr. Hume, and other men of genius and learning. Having failed in his endeavours to supply a vacancy in one of the churches of St. Andrew's, he was soon after made professor of logic, and by a patent from the crown, professor of rhetoric and belles lettres. In his lectures on logic and metaphysics, he deviated from the old plan of syllogisms, modes, and figures, and introduced substantial improvement by furnishing his pupils with an analysis of the powers of the mind, and by leading them to investigate the various kinds of evidence, of knowledge or truth. His history of Philip II. advanced his reputation during the period of his life; and it was farther enhanced by his history of Philip III., which was published after his death; of which latter he only wrote the first four books, the other two being supplied by Dr. William Thomson, the editor, at the desire of the guardians of his children. He succeeded Tulideph as principal of the university by the interest of the earl of Kinnoul; but his death, in 1780, soon deprived him of this honour. By his wife, who was daughter of Mr. Shaw, professor of divinity in St. Mary's college, St. Andrew's, he had five daughters, who survived him. Gen. Biog.

Watson, Richard, an English prelate, eminently distinguished by his talents, acquirements, and character, was born at Haverham, in Wiltshire, in August 1737. He was the descendant of an ancient family, deriving its remote origin from Scotland, and occupying, for several generations, a small estate at Hardendale, near Shaw, where his father was born in the year 1672. In 1693 his father was appointed head master of Haverham-school, which he conducted with great reputation for nearly forty years. Among other pupils who enjoyed the benefit of his instruction, we may mention Ephraim Chambers, the well-known author of the Dictionary of Arts and Sciences (see his article), Mr. Prefton, afterwards bishop of Ferns, in Ireland, and the subject of this memoir. To this school belonged two exhibitions, (now of 5cl. a year each,) one to Trinity college, in Cambridge, and the other to Queen's college, Oxford; the former of which was enjoyed by Mr. Prefton, and afterwards by his school-fellow, Mr. Watson. In the year 1758, these two scholars, being then bishops, testified their regard for the place of their education by repairing the school-house, and by affixing to it a Latin inscription, expressing their respect for the memory of its pious founder, and of Mr. Watfon's father. To his mother also Mr. Watfon pays a tribute of grateful and affectionate remembrance, describing her as a charitable and good woman, to whom he was indebted for imbuing his young mind with principles of religion, which never forsook him; and observing more generally, that "the care of the mother precedes that of the school-mater, and may stand upon the raja tabula of the infant mind, characters of virtue and religion which no time can efface." Soon after the death of his father, in November 1753, Mr. Watfon was sent to the University, and admitted a fizer of Trinity college, in Cambridge, on the 3d of November, 1754. Apprized that his patrimony, which was 350l., would be barely sufficient to defray the charges of his education, and having no expectations from any of his relations, he determined to fabricate his own fortune, and applied with affiduity and ardour to his academic studies. Before he had been six months at college, a circumstance occurred which indicated his talents for metaphysical disputation, and which contributed in no small degree to his reputation in this department of science. As he attended the college-lectures, which were then delivered to the undergraduates in the hall, immediately after morning-prayers, during term-time, he was asked by Mr. Brocket, the head lecturer, whether Clarke had demonstrated the absurdity of an infinite succession of changeable and dependent beings? to which question he replied non; and being asked his reasons for so thinking, he rammed out, as he says, in barbarous Latin, "that Clarke had enquired into the origin of a series, which, being from the supposition eternal, could have no origin; and into the first term of a series, which, being from the supposition infinite, could have no first." This circumstance was collected four years afterwards, when he took his bachelor's degree, and laid the foundation of his acquaintance with Dr. Law, then master of Petchhoe, and reckoned one of the best metaphysicians of his time; from which he derived, as he acknowledges, much knowledge and liberality of sentiment in theology. Not satisfied with his rank of fizer, he aspired to a scholarship, and succeeded in obtaining it, on the 2d of May, 1757, a year before the usual time. Thus advanced in rank, his expenses increased, but they were more than counterbalanced by the advantage attending it. Dr. Smith, who was then master of the college, took occasion to nominate him to a particular scholarship (lady Jermy's); and at the same time recommended Saunders's Fluxions, just published, and some other mathematical books, to his perusal; thus, as he says, "giving a spur to my industry, and wings to my ambition." At this time he had resided in college two years and seven months, without leaving it for a single day; and during this period, he had acquired some knowledge of Hebrew, improved himself greatly in Greek and Latin, made considerable proficiency in mathematics and natural philosophy, and studied with much attention Locke's Works, King's book on the Origin of Evil, Puffendorf's Treatise "De Officio Homini et Civis," and some other books on similar subjects. Conceiving himself entitled to some degree of relaxation, he set out, in May, 1757, on a visit to his elder and only brother at Kensington, who was the first curate of a new chapel erected there, and to the building of which he had liberally contributed. This brother lived frely, spent his fortune, injured his constitution, and died when the subject of our memoir was about the age of 53. With the death of his brother and singular liberality, he paid his debts, to the amount of almost his whole property. In the beginning of September he returned to college, with a purpose to make his alma mater the mother of his fortunes. He was then only a "junior fophs," but such was his reputation, that he was solicited to become private tutor to Mr. Luther and Dr. Strachey. From the
time in which he undertook this charge he was employed for thirty years, and as long as his health lasted, in instructing others, without much instructing himself, as he fuggles, and in precluding at disquisitions in philosophy or theology, from which, after a certain time, he derived little intellectual improvement. Addicted, whilst an undergraduate, to associate with those whom collegians call the belt company, such as idle fellow-commoners, and other persons of fortune; he soon perceived that he was pursuing a mistaken course; and this conviction was more sensibly felt, when he often saw, on his return home at one or two in the morning, from some of his evening feetsivities, a light in the chamber of a fellow-student of the same standing with himself. His jealousy was thus excited, and the succeeding day was always devoted to hard study; nor would he allow himself the leisure for dinner. In his solitary walks he prosecuted the study of mathematics and philosophy without book, or pen and paper; and went through tedious and intricate demonstrations by the mere exercise of his mental powers. These walks were so frequent, that among those who did not know how he was employed, he incurred the charge of being a longer; but the sequel of his history sufficiently proves the injustice of the charge.

WhilSt abstract studies occupied his chief attention, he did not neglect other pursuits. Every day he imposed upon himself the task of composing a theme in Latin or English. Among the first of his compositions of this kind, the subject of that written in English was "Let tribunes be granted to the Roman people," and that of the Latin was "Socius Italicus datus Civitas?" the subjects of both were suggested by him to a perusal of Vertot's "Roman Revolution;" and to his account of this incident he adds, "We books of such kind put into the hands of kings during their boyhood, and Tory-trash at no age recommended to them, kings in their manhood would scorn to aim at arbitrary power through corrupted parliaments." He also introduces this reflection on the choice of his subjects: "They shew that a long commerce in the public world has only tended to confirm that political bent of my mind in favour of civil liberty, which was formed in it before I knew of what selfish and low-minded materials the public world was made." In the course of Mr. W.'s classical reading, to which he devoted the afternoon, whilst the morning was occupied by mathematics, he informs us, that Democritus was the orator, Tacitus the historian, and Periplus the satirist, whom he most admired. At an early period of his life, Mr. W. inclined to the opinion which has in later times been more prevalent, that the soul is not a distinct substance from the body; though he professes not to have troubled himself much with perplexing disquisitions concerning liberty and necessity, matter and spirit; shewing, however, on all occasions, his faith in Christianity, as founded on testimony, and more especially on the testimony concerning the resurrection of its divine founder; and his belief of a future state of retribution and immortality. His speculations on matter and spirit are not likely, in our judgment, to illumine the darknes, and to resolve the difficulties that involve this subject. As to the story, recorded in the French Encyclopedia (art. Mort), of a man who came to life after having been six weeks under water, we cannot help considering it as fabulous; but whether it be true or false, it appears to us to afford little satisfaction with regard to the question in dispute. Nor does his reasoning about the essential properties of extension, solidity, mobility, divisibility, and inactivity, as common properties, belonging equally to a table, tree, oyster, and man, and the addition of life to the matter of the tree, of life and perpectivity to that of the oyster, and to that of the man, life, perpectivity, and thought, seem to have given very great satisfaction to himself. "Whether life can exist without perpectivity," he says, "or perectivity without thought, are subtle questions, not admitting perhaps, in our present state, a positive and clear decision either way. Physical and metaphorical difficulties present themselves on every subject, and ultimately baffle all our attempts to penetrate the darknes in which the divine mind envelopes his operations of nature and grace."

In January 1759, Mr. W. took his degree of bachelor of arts. In the first year of his being moderator, he introduced an alteration in the mode of obtaining this degree, which has been continued ever since. "At the time of taking it, the young men are examined in classes, and the classes are now formed according to the abilities shewn by individuals in the schools. By this arrangement, persons of nearly equal merits are examined in the presence of each other, and flagrant acts of partiality cannot take place. Before this alteration was made, they were examined in classes, but the classes consisted of members of the same college, and the best and the worst were often examined together." In the first year of his being moderator, Mr. Paley, afterwards so well known, and a Mr. Freer of Norfolk, were examined together; and Mr. Paley, being Mr. Freer's superior, was made senior wrangler, though it was reported that the grandfather of Mr. Freer had propounded to give 1000l. if he were admitted to this honour. This gentleman afterwards candidly acknowledged that he deferred only the second place; and this declaration was obviously the result of their having been examined together. One of the questions propounded by Mr. Paley for his set was "Æternum panemur contradicit Divinis attributis." This question, though accepted by Mr. W., occasioned an alarm; but in order to allay all disquieting apprehensions, Mr. P. was allowed to put in now before contradicit, and the alarm subsided. This, however, says Mr. W., is a subject of great difficulty. "It is observed, on all hands, that the happiness of the righteous will be, strictly speaking, everlasting; and I cannot see the justness of that criticism which would interpret the same word in the same verse in a different sense. (Matt. xxx. 46.) On the other hand, reason is shocked at the idea of God being considered as a relentless tyrant, inflicting everlasting punishment which answers no benevolent end. But how is it proved that the everlasting punishment of the wicked may not answer a benevolent end, may not be the means of keeping the righteous in everlasting holiness and obedience? How is it proved, that it may not answer, in some other way unknown to us, a benevolent end in promoting God's moral government of the Universe?"

In October 1760, Mr. W. was elected a fellow of Trinity college, although by that appointment he was put over two of his seniors of the same year; and in the following November became assistant tutor to Mr. Backhouse. Soon after this he declined accepting the curacy of Clermont; and he also relinquished his design of going out as chaplain to the factory at Bencoolen. "You are far too good," said the master of the college to him, "to die of drinking punch in the torrid zones." Afterwards he reflected with gratitude and self-complacency on his disappointment of an opportunity of becoming an Afsatic plunderer. "I might not," he says, "have been able to resist the temptation of wealth and power, to which so many of my countrymen have yielded in India."

At the commencement of 1762 he took his degree of M.A., and in the following October was made moderator for Trinity college. In his "Memoirs," he recites the questions which were at that time the subjects of scholastic exercises,
erects, and from their nature and variety he justly infers the importance of these exercises.

In February 1764 an occasion was afforded him of manifesting his friendly attachment to Mr. Luther, one of the members for Ely, who had been formerly his pupil, and his disinterested anxiety for his happiness. Having heard that he had separated from his wife, and was hafily gone abroad, he immediately prepared to seek him, and to impart to him, if possible, some consolation. Although he had no money, and could not speak a word of French, he determined on his journey; and having borrowed 500l., and provided a French and English Dictionary, he pofted to Dover, and hastened to Paris, where he found his disconsolate friend. After twelve hours' fly at Paris, he returned to England; and having crossed the channel four times, and travelled 1200 miles in very bad weather within a fortnight, he brought his friend back to his county and his family. Of Mr. Luther, he says that "he was a thorough honest man, and one of the friends I ever loved with the greatest affection."

In November 1764, he was unanimously elected by the senate to succeed Dr. Hadley, as professor of chemistry; and though at this time he knew nothing of chemistry, he procured an operator from Paris, and immersed himself in his laboratory, so that in 6 months from his election he read a course of chemical lectures to a very full audience, and another in November 1766. For the fourth time he was made moderator in October 1765, and in 1766 made his last speech in Latin to the senate. Besides other improvements in the university education, which he had proposed on former occasions, he now recommended the institution of public annual examinations, in preferred books, of all the orders of students. In 1774 this subject was revived and enforced by Mr. Jebb. The design was unequivocally approved by the chancellor of the university, the duke of Grafton. After a long discussion of the subject, the regulations drawn up by the syndics were proposed to the senate, and were rejected by the "Non Regent Houfe," 47 against 43. In 1764 application was made for a stipend to the professor of chemistry; and after considerable delay, 100l. a year was obtained: and this grant paved the way for similar stipends to the professors of anatomy, botany, and common law. In October 1767, Mr. Watson succeeded Mr. Backhouse as head tutor in Trinity college, and, for the short period during which he retained the office, discharged its duties with conscientious diligence. "In this," he says, "and the two following years, I read chemical lectures to very crowded audiences, in the month of November. I now look back with a kind of terror at the application I used in the younger part of my life. For months and years together, I frequently read three public lectures in Trinity college, beginning at 8 o'clock in the morning; spent four or five hours with private pupils, and five or six more in my laboratory, every day, besides the incidental busines of prefiging in the fops schools."

In 1768 he composed and printed his "Institutiones Metallurgiae," and about the same time prefented to the Royal Society a paper on the solution of faults, and was elected a fellow of that society. In the following year he published his Affize Sermon, which he dedicated to Mr. Luther. Upon the vacancy in the office of regius professor of divinity, occasioned in October 1771 by the death of Dr. Rutherford, Mr. Watson proposed to become a candidate; but he was then neither bachelor nor doctor in divinity; and without being one of the candidates, he could not be admitted as a candidate. Prompt, however, in the execution of all his measures, though he had only seven days for the accomplishment of his object, he obtained the king's mandate for a doctor's degree, and was created a doctor on the day previous to that appointed for an examination of the candidates. The subjects on which he was to write were, the reconciliation of the genealogies in Matthew and Luke, and the interpretation of the passage "What shall they do that are baptized for the dead?" 1 Cor. xi. 29. He was also appointed to read a Latin dissertation on Gen. x. 32.

At length he was unanimously elected, having, as he says, by hard and incessant labour for 17 years, attained, at the age of 34, the first office for honour in the university, and, exclusive of the mastership of Trinity college, he made it the first for profit; having advanced it from 330l. a year to at least 1000l. Having been promoted to this honourable and important office, he devoted himself, with his accustomed resolution and perseverance, to the study of divinity; making the Bible the object of his investigation, and feeling no concern about the opinions of councils, fathers, churches, bishops, or other men, as little inspired as himself. Although he was called by the master of Peterhouse, avubadefex, the self-taught divine; and though the professor of divinity had been nicknamed "Mallens Harrectorum," he professes that his mind was wholly unbiased; without prejudice against or predilection for the church of England, and actuated only by a sincere regard for the church of Christ, and an insuperable objection to every degree of dogmatical intolerance. "I never troubled myself," thus he proceeds, "with anwering any arguments which the opponents in the divinity schools brought against the articles of the church, nor ever admitted their authority in decision of a difficulty. But I used, on such occasions, to say to them, holding the New Testament in my hand, "En fuerim codiscis! Here is the fountain of truth; why do you follow the streams derived from it by the sophistry, or polluted by the passions of men? If you can bring proofs against any thing delivered in this book, I shall think it my duty to reply to you: articles of churches are not of divine authority; have done with them; for they may be true, they may be false; and appeal to the book itself." This mode of disputing gained me no credit with the hierarchy; but I thought it an honest one, and it produced a liberal spirit in the university."

About the close of the year 1771 our author printed an Essay on the subject of chemistry, which was dispersed among some few friends; but it was unjustly charged by the authors of the "Journal Encyclopédique," with favouring the "Systeme de la Nature." The author renounced, and the periodical journals made an apology. In the following year Dr. Watson published two letters to the members of the house of commons, under the signed name of a Christian Whig, the second of which was inscribed to Sir George Savile. In 1773, upon maturely weighing the question concerning the abstract right which a national church may claim of requiring subscription to human articles of faith from its public ministers, he published "A Brief State of the Principles of Church Authority," which he delivered as a charge to the clergy of his diocese, in June 1813. In this tract it is maintained, that every church has a right of explaining to its ministers what doctrines it holds; and of permitting none to minister in it, who do not profess the same belief with itself. With respect to another question, viz. whether the majority of the members of any civil community have a right to compel all the members of it to pay towards the maintenance of a set of teachers appointed by the majority to preach a particular system of doctrines, this may admit a serious discussion. Our author once thought the majority had this right in all cases, and he afterwards apprehended that they have it in many. But a safe may happen,
WATSON.

happen, in which the established religion of a country may be the religion of a minority of the people, that minority at the same time possessing a majority of the property, out of which the ministers of the establishment are paid; and if this should occur, our author seems to be undecided in his judgment. His sentiments as to the expediency of requiring from the ministers of the established church a subscription to the present articles of religion, or to any human confession of faith, rather than a declaration of belief in the scriptures, as containing a revelation of the will of God, may be collected from his two pamphlets, published "A Christian Whig," and "A Confident Protestant."

In adverting to these tracts, our author reflects with satisfaction on the coincidence of his sentiments, on many points civil and religious, with those of bishop Hoadly, though he has been sarcastically and injuriously called "a republican bishop."

On the 21st of December 1772, Dr. Watfon married the eldest daughter of Edward Wilson, esq. of Dallum Tower, in Westmorland; and the connection was a source of uninterrupted satisfaction and felicity. Having obtained, by the intered of the duke of Grafton with the bishop of St. Asaph, a licence in Wales, he exchanged it, by the same intered, on his return to Cambridge, for a prebend of Ely; and this favour was granted, though the duke and Dr. Watfon held different political opinions. They afterwards differed also in their religious sentiments; the duke having avowed himself an Unitarian. Referring to him under this denomination, Dr. Watfon, with landlord liberality, declares, "that he is happy in feeling a perfom of his rank professing with intelligence and sincerity Christian principles. If any one thinks that an Unitarian is not a Christian, I plainly say, without being myself an Unitarian, that I think otherwise."

Dr. Watfon's political principles are well known. From his earlies youth to his dying day he was a Whig, in that sense of the term which is well understood, and need not here be explained. In 1776 it came to his turn to preach the restoration and accession sermons before the university; and they were both printed. The first was entitled "The Principles of the Revolution vindicated." Although it was written with great caution, a report was circulated in London that it was treasonable; but when Mr. Dunning (afterwards lord Ashburnam) was asked what he thought of it, he replied, "that it contained such treason as ought to be preached once a month at St. James's." However, it gave great offence to the court, and, in Dr. Watfon's opinion, continued to be an obstacle to his preferment. The author was much abused, in consequence of the publication of this sermon, by ministerial writers, as a man of republican principles; but by Mr. Fox, and others of his chfts, it was very highly commended.

In the same year, 1776, Dr. Watfon published his "Apology for Chriftianity," in reply to Mr. Gibbon's obnoxious chapters in his "History of the Decline and Fall of the Roman Empire." His treatment of the historian was liberal and conciliatory, and was acknowledged with great courtesy and respect. In February 1780, Dr. Watfon preached, at the request of the vice-chancellor, the fall sermon before the university, which became very popular, and was widely circulated. In May of this year he published a charge to the clergy of the archdeaconry of Ely, at his first visitation; the primary object of which charge was to recommend an establishment at Cambridge, for the express purpose of translating and publishing Oriental MSS., wherever found. Dr. Keene, bishop of Ely, expressed his approbation of this charge; but as he reflected on the author's politics, he retorts it by observing in a letter to his lordship, "My politics may hurt my interest, but they will not hurt my honour. They are the politics of Locke, Somers, and Hooker; and in the reign of George II., they were the politics of this university." In February 1781, our author was prevented by the duke of Rutland with the rectory of Knapholt, in Leicestershire; and as he was just then printing the first two volumes of Chemical Essays, he availed himself of this opportunity of dedicating them to his grace. In 1782, Soame Jenyns published his Disquisitions on various subjects, the seventh of which advanced principles very opposite to those which were contained in the "Principles of the Revolution vindicated," with occasional glances at that sermon. Although our author was fearfully recovered from a dangerous illness, he drew up, in the course of a few hours, "An Answer to the Disquisitions, &c." Upon a change of ministry, lord Shelburne was induced to confer the bishopric of Landaff on Dr. Watfon; and on the 26th of July 1782, he killed himself on his promotion. But he was not very much gratified by this advancement; because lord Shelburne had expressed to the duke of Grafton his expectation that he would occasionally write a pamphlet for their administration. The duke, however, did the new prelate the justice to affine his lordship, that he had totally mistaken the character of the bishop; for though he might write as an abstruse question, concerning government, or the principles of legislation, it would not be with a view of affiling any administration. I had written," says the independent and high-spirited bishop, "in support of the principles of the revolution, because I thought those principles useful to the state, and I favoured them vilified and neglected. I had taken part in their petitions against the influence of the crown, because I thought that influence would destroy the constitution, and I saw that it was increasing. I had opposed the supporters of the American war, because I thought that war not only to be inexpedient, but unjust. But all this was done from my own sense of things, and without the least view of pleasing any party; I did, however, happen to please a party, and they made me a bishop. I have hitherto followed, and shall continue to follow, my own judgment in all public transactions: all parties now understand this, and it is probable that I may continue to be bishop of Landaff as long as I live. Be it so. Wealth and power are but secondary objects of pursuit to a thinking man, especially to a thinking Christian." Lord Shelburne seems to have courted an intimate acquaintance with the bishop; alleging that he had Dunning to affinit him in law points, and Berry in army concerns, and expressing his wish to consult him in church matters. The bishop availed himself of this opportunity, and propounded to the minister a plan by which service might be done to religion and to the established church. Being invited to dine with his lordship, he put into his hand a paper, containing the following scheme of reform, comprehending the doctrine, the jurisdiction, and the revenue of the church of England. The two following hints on the subject of the revenue he submitted to the consideration of his lordship:—First, a bill to render the bishoprics more equal to each other, both with respect to income and patronage; by annexing, as the richer bishoprics became vacant, a part of their revenues, and a part of their patronage, to the poorer. By a bill of this kind, the bishops would be freed from the necessity of holding ecclesiastical preferments in commendam; a practice which bears hard on the rights of the inferior clergy. Another probable consequence of such a bill would be, a longer residence of the bishops in their several dioceses, from which the best 

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sequences both to religion, the morality of the people, and to the true credit of the church, might be expected: for the two great inducements to wish for translations, and consequently to reside in London, namely, superiority of income, and excellency of patronage, would in a great measure be removed. Second, a bill for appropriating, as they become vacant, one half, or a third part, of the income of every deanery, prebend, or curacy, of the churches of Welf-, windor, Canterbury, Chriftchurch, Worcester, Durham, Ely, Norwich, &c. to the fame purpofes, mutatis mutandis, as the firft fruits and tenths were appropriated by Queen Anne. By a bill of this kind, a decent provision would be made for the inferior clergy, in a third, or fourth part of the time which Queen Anne’s bounty alone will require to effeit it. A decent provision being once made for every officiating minifter in the church, the refidence of the clergy in their cures might more reasonably be required than it can be at prefent, and the licence of holding more livings than one be reftricted.” Lord Shelburne wished to be in- formed if nothing could be gotten from the church to relieve the burdens of the state; to which the bishop replied, that the whole revenue of the church would not yield, if it were equally divided, which could not be thought of, above 150l. a year to each clergyman, which could not be thought too ample; and in a political view it would be highly inex- pedient, unless government would be contented to have a beggarly and illiterate clergy, which no wise minifter would ever wish to fee. In preparation of the fame plan, the bishop sent a letter to the archbishop of Canterbury, and a copy to lord Shelburne, the duke of Grafton, the duke of Rutland, and lord John Cavendish respectively. The minifter discouraged the bufinefs, and earnestly diffuaded the bishop from any immediate publication of it. Upon the resignation of lord Shelburne, who, by an exercife of pre- rogative, had been nominated by the king without the re- commendation of the cabinet, the coalition minifter, formed of lord North, and others who had for many years repro- bated his political principles, came into power. This cir- cumftance of the coalition roused our prelate’s indignation, and led him to entertain a very unfavourable opinion of the difinterestednefs and integrity of thofe to whom he had been invariably attached. Although the badnefs of the peace, and the fuppoefed danger of trufing power in the hands of lord Shelburne, were the ofenfible reafons for this coalition, personal diflike of him, and a defire to be in power them- felves, were, in the bishop’s judgment, the real ones. This diftenfion of the Whigs, he fays, did more injury to the confitution than all the violent attacks on the liberty of the subject, which were fubfsequently made during Mr. Pitt’s ad- miniftration. “This apoftacy from principle in the coali- tion minifter ruined,” as he conceived, “the confidence of the country, and left it without hope of foon feeing another repreftable oppofition on confitutional grounds; but it flamped on the hearts of millions an impressi.on which will never be effaced, that patriofm is a scandalous game played by publique men for private ends, and frequently little better than a selfish struggle for power.”—“It is,” he adds, “a principle with all parties to require from their adherents an im- plicit approbation of all their meafures: my spirit was ever too high to admit to such a disgraceful load of political connection.”—“To forget all benefits, and to conceal the re- memberance of all injuries, are maxims by which political men lose their honour, but make their fortunes.”

Our prelate’s letter to the archbishop of Canterbury was published in the interval between lord Shelburne’s resignation and the appointment of the duke of Portland to the head of the treafury; but though a copy of it was fent to each bishop, none thought proper to acknowledge it except Dr. Portal, then bishop of Chefter. Soon after the failure of Mr. Fox’s East India bill, to which Dr. Watfon was ad- verfe, Mr. Pitt was appointed first lord of the treafury; and though he had continued in office for feveral weeks previously to the difsolution of parliament, March 25th, 1784, in direct opofition to the majority of the house of commons, which in the judgment of our prelate established a dangerous pre- ce dent, yet deference to the fentiments of the nation declared by numberles adresses to the king againft the coalition minif- try, induced him to acquiefce. In July of this year he wrote a letter to Mr. Pitt, recommending an union of Brit- ain and Ireland on an equal and liberal footing; but it was not accomplished till fifteen years after this period, and not, as the bishop obferves, “in the liberal way it ought to have been done.” Enlarged and liberal as were his sentiments of toleration, he neverthelefs regarded the church of Rome as a perfecling church; and he thought it was more necejfary to guard againft the danger to be apprehended by Proteft- ants in a country where popery is simply tolerated than where it is the established religion. On another occafion he expreffes sentiments which must lead the friends of Ca- tholic emancipation to conclude, that he was not favourable to this object. “The perfecling spirit of the Roman church remains in the hearts of the generality of its mem- bers,” he fays, “and while it does remain, popery must be watched, intimidated, and refrained.” In a letter to Mr. Wakefield written in 1784, he avows his belief of the pre- exilence of Chrifl as the doctrine of the New Testament; but at the fame time he is far from concurring with thofe who brand the supporters of it as enemies to the Christian fystem. In the fame year he addressed a letter to Mr. Wy- vill, expressing his warmeft wishes for parliamentary reform, which Mr. Pitt feemed at the commencement of his ad- miniftration inclined to promote. In 1785 he published his “Collection of Theological Tracts,” in six volumes, in- tended for the benefit of young perfons, who could not af- ford to purchase many books in divinity; the defign was laudable, and was generally approved; though he fays, the bishops were not pleased with his having printed fome tracts originally written by Diśfenters. In January 1786 he left his friend Mr. Luther, with whom he had lived on terms of the moft affectionate intercourse for thirty years; and in mentioning this circumftance he gratefully acknowledges his generous bequeft, which enabled him to preferve his independence, and to provide for his family. To his Suffolk efflate, from the sale of which he derived 20,500l., this generous testator added the entail of his eflate in Effex. Having, in the year 1782, published a third volume of his Chemical Essays, he prefented to the public a fourth volume in 1786. About this time application was made to him by government for advice relating to the improvement of gunpowder; and he fugged that a plan of making charcoal by distilling the wood in close vefsels, which was carried into execution at Hythe in 1787, and which produced a confiderable saving in the manufacture of this article.

Dr. Watfon, having been attacked with a diforder in 1781, which continued and rendered the diſcharge of his duty, as profeffor of divinity, very irksome to his feelings, and likely to haften the termination of his life, intimated to Mr. Pitt his wishes for fome kind of preferment that would enable him to resign his profefforship; his church income, exclusive of it, being only about 1200l. a year. This ap- plication he very reluctantly renewed, but it produced no effect; and the confequence was a kind of remonftrance, in the tone of complaint, on the part of the bishop to the mi-
WATSON.

About this time Mr. Pitt consulted the bishops about the repeal of the Test and Corporation Acts; and of all the bishops who were assembled for the discussion of the subject, bishop Waton and bishop Shipley were the only two who voted, that they ought not to be maintained. The question was afterwards lost in the commons by a majority of 78; 178 to 100. When it was brought forward again in 1789, it was lost by a majority of 20; 122 to 102. But in 1790, the majority against it was 194: 296 to 105: the clamour of "the church is in danger" having in the mean while been widely and loudly circulated, under the sanction of some imprudent or misunderstood expressions in the publications of Dr. Hartley and Dr. Priestley. The bishop's interest with the minister was not promoted by the part which he took on this occasion, and much less by his parliamentary speech against Mr. Pitt's commercial treaty with France. Soon after this he was very much enfeebled by a dysentery; and upon his return from Bath to Cambridge in 1787, the senate appointed Dr. Kipling to be his deputy as professor, with a salary amounting in a course of time to two-thirds of the value of the professorship, when Dr. Watson first undertook it. At the ensuing commencement he delivered a kind of farewell address to the university, in which he expressed his warmest wishes for its prosperity; after having been incessantly engaged in its business for more than thirty-three years. After the commencement he took a journey to Westmoreland, with a view to the re-establishment of his health. He now determined to become an agriculturist; and his pursuits in this department, as an improver of land and planter of trees, were so favourable to his health, and upon the whole so profitable, that he says in the year 1809, "I feel much satisfaction at this moment in having, by my own exertions, wholly counteracted the effects which might otherwise have followed the neglect I have experienced from the court or from its ministers, or from both, that I sincerely pity, and cordially forgive the little defects of mind, which, in some one or other, has occasioned it." The bishop relates an incident which occurred on occasion of his attending a levee in November 1787, and which sufficiently evinced the pains that had been taken to inculc wrong notions of his political principles into his majesty's mind. "I was biding," he says, "next to a Venetian nobleman; the king was conversing with him about the republic of Venice, and hastily turning to me said, 'there now, you hear what he says of a republic.' My answer was, 'Sir, I look upon a republic to be one of the worst forms of government.' The king gave me, as he thought, another blow about a republic. I answered that I could not live under a republic. His majesty still pursued the subject: I thought myself insulted and firmly said, 'Sir, I look upon the tyranny of any one man to be an intolerable evil, and upon the tyranny of a hundred to be a hundred times as bad;' thus ended the conversation."

Although Dr. Watson, as professor of divinity, had been for many years a chartered member of the society for propagating the gospel in foreign parts, he had never subscribed to it nor attended its meetings; because its missionaries were more busily employed in bringing over Dillenets to episcopacy than in converting heathens to Christianity. In the year 1788 he published a charge which he had delivered at his visitation, entitled "An Address to Young Persons after Confirmation." Towards the close of this year and the commencement of the next, he took an active part in the business of the regency, occasioned by the king's mental de-arrangement; and in an elaborate speech delivered in the house of lords January 22d, 1789, he discoursed, with singular ability, the subject in debate between Mr. Fox, who asserted "that the prince of Wales had a right to assume the regency," and Mr. Pitt, who had said, "that the prince of Wales had no more right to assume the regency than any other man in the kingdom had." The part he took on this occasion is said to have offended the queen; who, as he says, "distinguished by different degrees of courtesy on the one hand, and by mediatis affronts on the other, those who had voted with, and those who had voted against the minister." At the drawing-room, held on the king's recovery, the bishop was received with a degree of coldness, "which would have appeared to herself ridiculous and ill-pleased could she have imagined how little such a mind as mine regarded, in its honourable proceedings, the displeasure of a woman, though that woman happened to be a queen." The prince of Wales, who was witness to this conduct, paid particular attention to the bishop, invited him to dine at Carlton-house, and entered into a familiar conference with him; the bishop on the occasion "advising him to persevere in dutifully bearing with his mother's ill-humour, till time and her own good sense should disentangle her from the web which ministerial cunning had thrown around her." When the bishop, before the close of the interview, declared that he was sick of parties, and should retire from all public concerns, "No," said the prince, "and mind who it is that tells you so, you shall never retire; a man of your talents shall never be lost to the public." The bishop's reflection subjoined to this anecdote is, "I have now lived many years in retirement, and, in my 75th year, I feel no wish to live otherwise.

About ten years after the publication of the tract which he had given to the young persons of his diocese, already mentioned, Mr. Ashdown of Canterbury addressed two letters to him, in which he contended that the distinction of ordinary and extraordinary operations of the Holy Spirit is not founded in scripture, and that if it were, both operations ceased with the apostolic age. In reference to this opinion, the bishop declares, "I am not ashamed to own, that I give a greater degree of assent to the doctrine of the extraordinary operation of the spirit in the age of the apostles, than I do to that of his immediate influence, either by illumination or sanification, in succeeding ages. Notwithstanding this confession, I am not prepared to say, that the latter is an unscriptural doctrine; future investigation may clear up this point, and God, I trust, will pardon me an indecision of judgment proceeding from an inability of comprehension. If it shall ever be flown, that the doctrine of the ordinary operation of the Holy Ghost is not a scripture doctrine, Methodism, Quakerism, and every degree of enthusiasm, will be radically extinguished in the Christian church; men, no longer believing that God does that by more means which may be done by fewer, will wholly rely for religious instruction, consequent conversion, and subsequent salvation, on his Word." In the summer of 1789, our bishop, in pursuit of his plan for retiring from public life, laid the foundation of his house on the banks of the Winandermere; where he continued till his death. On occasion of the publication of "Hints to the New Association, recommending a Revival of the Liturgy, &c." in 1789, by the duke of Grafton, two pamphlets were in the following year published in opposition to these "Hints." The bishop made a reply to these attacks; and took a comprehensive view of the subject. Although he was diffused from publishing his tract, it soon appeared under the title of "Considerations on the Expediency of revising the Liturgy and Articles of the Church of England," by a Conscientious Protestant. Moreover, it was proposed, in conversation with the duke of Grafton, to commence a reform, by the introduction of a bill into the hous
WATSON.

house of lords, for expunging the Athanasian creed from the Liturgy; but on account of the French revolution, the design was postponed. In this connexion, we cannot forbear mentioning what is called the Windsor anecdote. It is as follows; and given by the bishop on the authority of Dr. Heberden: "The clergyman there, on a day when the Athanasian creed was to be read, began with "Whosoever will be saved, &c. &c. the king, who usually responded with a loud voice, was silent; the minister, repeating, in a higher tone, his "Whosoever," the king continued silent; at length the Apostle's creed was repeated by the minister, and the king followed him throughout with a distinct and audible voice."

"I certainly dislike," says the bishop, "the imposition of all creeds formed by human authority; though I do not dislike them, as useful summaries of what their compilers believe to be true, either in natural or revealed religion." In a letter to the duke of Grafton, dated October, 1791, he briefly states his sentiments on several subjects of importance. Among other observations that deserve attention, he says, "In England we want not a fundamental revolution; but we certainly want a reform both in the civil and ecclesiastical part of our constitution; men's minds, however, I think, are not yet generally prepared for admitting its necessity. A reformer of Luther's temper and talents would, in five years, persuade the people to compel the parliament to abolish tithes, to extinguish pluralities, to enforce residence, to confine episcopacy to the overseeing of dioceses, to expunge the Athanasian creed from our liturgy, to free Diffenters from legal acts, and the ministers of the establishment from subscription to human articles of faith. These, and other matters respecting the church, ought to be done: I want not courage to attempt doing what I think ought to be done; and I am not held back by considerations of personal interest: but my temper is peaceable, I dislike contention, and trust that the still voice of reason will at length be heard.—As to the civil state, it cannot long continue as it is, &c. &c." In a charge delivered in 1792, the bishop touched on several subjects of importance and general interest; and among other things on the injustice and impolicy of our Telt and Corporation Acts. "There seem to me," says our prelate, "but two reasons for excluding any honest man from eligibility to public office;—want of capacity to serve the office, and want of attachment to the civil constitution of the country. That the Diffenters want capacity will not be affected; that they want attachment to the civil constitution of the country is affected by many, but proved by none."—"The Diffenters are neither Tories nor Republicans, but friends to the principles of the revolution;" but their conduct since the revolution, and at and since the restoration, proves that they have no design to undermine the constitution of the country.

"But it may be said, that inasmuch as the Diffenters are enemies to the church establishment, and that the state is allied to the church, that he who is unfriendly to the one must with the subversion of both. I think this reasoning is not just; a man may certainly wish for a change in an ecclesiastical establishment, without wishing for a change in the civil constitution of a country. An Episcopalian, e.g. may wish to see bishops established in all Scotland, without wishing Scotland to become a republic; and he may wish that episcopacy may be established in all the American states, without wishing that monarchy may be established in any of them. The protection of life, liberty, and property, is not inseparably or exclusively connected with any particular form of church-government. The blessings of civil society depend upon the proper execution of good laws, and upon the good morals of the people; but no one will attempt to prove, that the laws and morals of the people may not be as good in Germany, Switzerland, Scotland, under a Presbyterian, as in England or France, under an episcopal form of church-government," with much more to the same purpose.

In the year 1795 our bishop made a speech in the house of lords in favour of a motion by the duke of Bedford, "that no form of government which may prevail in France should preclude a negotiation with that country, or prevent a peace whenever it could be made consistently with the honour, interest, and security of the nation." In the following summer he published a charge, and two sermons, one of them entitled "Atheism and Infidelity refused from Reason and Scripture," and the other "The Christian Religion no Imposture." In 1796 he published "An Apology for the Bible," in defence of it against the furious abuse of Thomas Paine. Of this tract many thousands were distributed at a low price, both in England and Scotland; and we have reason to believe produced the most beneficial effects, not only in Great Britain, but in Ireland and America. In 1798 the bishop published an address to the people of Great Britain, which was of great service in rousing the spirit of the nation. In 1799 he delivered a speech, recommending and vindicating against objections a cordial union with Ireland, as an event which would enrich Ireland without impoverishing Great Britain; and that would render the empire, as to defence, the strongest in Europe. When Mr. B. Flower was brought to the bar of the house of lords for a breach of privilege in publishing something against the above-mentioned speech, the bishop, when he heard of it, declared, "that he should feel much more satisfaction in forgiving the man's malignity than in avenging it."

In 1805 the petition of the Roman Catholics of Ireland was taken into consideration by both houses of parliament, and rejected by great majorities in both. Previously to the discussion on this question, bishop Watson communicated his sentiments on the subject in a letter addressed to the duke of Grafton. As this is a question still fab judices, we shall here introduce the general heads of argument suggested in relation to it by the bishop. 1. The absolute justice of tolerating religious opinions, since no civil government can justly possess more power over its subjects than what individuals have consented to transfer to it when they entered into society; and no individual can give up the right of worshipping God according to his conscience, and therefore no government can justly abridge that right. 2. No civil government has any right to take cognizance of opinions either political or religious, but merely of men's actions. This principle, however, is liable to exception with respect to the public teachers of religion. 3. The established religion of every country ought to be the religion of the majority of the people; unless an exception be admitted, when the minority of the inhabitants possesses a majority of the property by which the establishment is maintained; and even in that case, humanity and policy, if not strict justice, require a co-establishment of the religion of the minority. 4. Great credit ought to be given to men of probity and talents, disclaiming, in express terms, the most obnoxious principles of the church of Rome; the odium of past transgressions ought not to be thrown upon those who had no concern in them. 5. Constitutionally speaking, the Catholic peers and commons have no more right to sit in parliament than a Catholic king has to sit upon the throne; and if the change of times is not yet such that a Protestant would endure the thought of a Catholic king upon the throne, it may be inquired upon what principle it is that a Protestant can endure
endure the thought of a Catholic legislator. The principle
may be the little comparative influence of a Catholic legisla-
tor, and his abjuration of temporal tenets formerly pro-
ferred by Catholics. 6. The progress of science has sub-
due the bigotry formerly too apparent not only in the church of
Rome, but in all the reformed churches; and it will never
be able, till a state of ignorance and barbarism recurs, to
rear up its head again. There is no probability of intel-
ligence and superstition ever more pervading Europe; and
the Catholic religion will continue to derive light from the
labour of learning. The learned Catholics are beginning
every where to soften the asperities of their religious tenets,
et and to apologize for what they cannot excuse. The Irish
exerty partake of the illumination of the age; and the
penalty will imitate the example of their superiors. 7. It
may be said that the church of Rome has not formally re-
nounced any of the doctrines maintained at the council of
Trent, and that the court of Rome has not abandoned any
of its pretensions to temporal dominion; yet Catholic, as
well as Protestant, states have every where spurned these
pretensions; and something very like a formal renunciation
of one of the most dangerous tenets of that church took
place in Russia more than twenty years ago. The emperors
Catharine gave permission to the Roman Catholics in her
dominions merely to exercise their religion; and to have
bishops of their own persuasion for the government of their
church. She was present at the consecration of the first
Catholic archbishop. When the ceremony had proceeded
to the administration of the oath usually taken by the bishops
of that church, the archbishop (that was to be) refused to
repeat the clause “Hereticos, seditiosos, et rebelles domino
nostrum papam, pro poebe perpetuar et impugnato.” On this
refusal, the ceremony was ended, fresh instructions were
required from Rome, and the then pope ordered the clause to
be omitted; and it has been since omitted, by the authority of
the pope, in the oath taken by the Irish bishops.

“My great objection,” says Waton, “to the church of
Rome is the uncharitable principle of the insalubrity of per-
fsons out of its pale; for this principle produces a perfec-
ting principle, and I must ever detest every species of
persecution. I cannot however believe that Catholic eman-
cipation will tend to the increase of the number of Catholics,
either in Ireland or in England; on the contrary, I think the
number would, by such a measure, be lessened. Nothing unites
men so much as any degree of persecution. Individuals,
otherwise of no consequence, either from talents or fortune,
become conspicuous, and acquire a degree of weight, when
connected with a party. Men claim merit from what they
call their sufferings, who would have no ground for claiming
it on any other species of defect.”

In subsequent letters addressed to Lord Grenville in 1810,
and to Sir John Cox Hipplesly in 1812, he gives the follow-
ing opinion of the veto: “The appointment of the Irish
Catholic bishops ought to be in the king, if they are to be paid
by the state; and if they are to be paid by the Catholics
themselves, it ought to be in them; but exclusive of all
foreign influence, recommendation, or confirmation. If
they do not accede to this, or to something similar to this,
they will act on a principle which I did not expect, nor can
approve.” In a letter to lord Hardwicke, dated April 2,
1812, he says, “I make no secret of my opinion; a cordial
reception of Catholics and Dissenters into the bosom of the
constitution, by the extinction of all disqualifications, is be-
come necessary to secure the independence of the empire,
and the safety of the country.”

In conseqence of an imputation of want of orthodoxy,
partly occasioned by a sermon published by the bishop, and
entitled “A Second Defence of revealed Religion,” he
makes the following reflections on the ground of this charge.
“What is this thing called orthodoxy, which mars the for-
tunes of honest men, misleads the judgment of princes, and
occasionally endangers the flability of thrones? Is the true
meaning of the term, it is a sacred thing, to which every
denomination of Christians lays an arrogant and exclusive
claim; but to which no man, no assembly of men, since the
apocalyptic age, can prove a title. It is freqently, among
individuals of the same sect, nothing better than self-suffi-
ciency of opinion, and pharisaical pride, by which each
man esteems himself more righteous than his neighbours. It
may, perhaps, be useful in cementing what is called the
alliance between the church and state; but if such an alliance
obstructs candid discussions, if it invades the right of pri-
ivate judgment, if it generates bigotry in churchmen, or
intolerance in state-men, it not only becomes inconsistent with
the general principles of Protestantism, but it impedes the
progres of the kingdom of Christ, which we all know is
not of this world.”

The next public occasion on which our bishop distin-
guished himself was on the debate which took place in the
house of lords, March 23, 1807, concerning the abolition
of the slave-trade. For the affirmative of this question he
delivered a speech, abounding with historical information
and found argument. When the administration that had been
formed on the death of Mr. Pitt was disdained, he expressed
in strong terms his disapprobation of the odious reason
alleged for its dismission, which was the king’s dislike of a
measure which had been brought forward in parliament re-
specting the Irish Catholic officers; and the requisition on
the part of his majesty of a pledge that this administration
would never more bring forward the question of granting
further indulgence to the Irish Catholics. This requisition
was considered by many as having a tendency dangerous to
the constitution; and to Dr. W. it appeared “to be not in
words, but in fact, a declaration of a vic volo.” On occa-
son of the dismission of this “half Whig, and half Tory
administration,” as he calls it, he communicated to lord
Grenville a resolution, which he conceived to be fit to be in-
introduced in the house of lords, whenever the subject
should be brought forward, and which lord Grenville actually
adopted in toto, as better in his opinion than any thing which
had occurred either to himself or to his friends. The reso-
nation was as follows: “Resolved, that whoever has ad-
vanced, or shall in future advise, his majesty to require from his
confidential servants a pledge, that they will, on any occasion,
abstain from submitting to his consideration any measure of
government which they, in their confidences, believe to be
conducive to the public weal, is and ought by this house to
be declared to be an enemy to the constitution of this coun-
try.” Soon afterwards he sent to the duke of Grafton a
legal firm resolution, which he thought might be more ac-
cetable to the then house of lords. Neither of these reso-
lutions, however, was ultimately adopted; but the resolu-
tion that was actually proposed was, after a debate which
lasted till 7 o’clock in the morning, negatived by a great
majority. A violent alarm against Popery and of the
church’s danger prevailed, during which the bishop declared
his opinion, “that it was both just, and in the state of Buo-
naparle’s strength and temper towards us, highly expedient,
to receive both Catholics and Dissenters into the bosom of
the constitution; but that it was improper to prefs any innova-
tion till the people were prepared to receive it; and that”
(in his opinion) “the time was not yet come for the general
adoption of such a political and equitable principle of go-
vernment. Toleration was in every man’s mouth; but do-
mination
mition over the faith of other men, exclusion from privileges possessed by themselves, and a disposition to the exercise of power without right, were in the hearts of a great part, probably of a majority of the people of Great Britain."

In reply to a letter, in which the writer expresses a wish that the bishop would answer Mr. Malthus's book, intituled "An Essay on Population," and in which, as he represents it, the author endeavours to establish a code of morality in opposition to the morality of the gospel, Dr. W. observes that Mr. Malthus appeared to him to be "endeavouring to shew the utility of bringing down the population of the earth to the level of the subsistence requisite for the support of man, (a proposition wanting no proof, since where there is no food, man must die,) and that in his judgment, his time and talents would have been better employed in the investigation of the means of increasing the subsistence to the level of the population." He says, however, that after having looked into this book, he was justified in neglecting to peruse it, as it thwarted the strongest propensity of human nature, and contradicted the most express command of God. "Increase and multiply," more especially as he was persuaded, "that the earth had not, in the course of 6000 years from the creation, ever been replenished with any thing like one half the number of inhabitants it would sustain."

The bishop might indeed well regret, as he frequently, perhaps too frequently, does, the attention to his merits, and claims on higher preferment than a poor Welsh bishop, which he had long experienced, after a long course of literary labour and public service. Mr. Pitt professed himself well disposed towards him, but alleged "that a certain person would not hear of it." "Notwithstanding this anecdote," says the bishop, "I cannot bring myself to believe that the king was either the first projector, or the principal actor in the force of negligence of a man whom they could not disannoy, of disaffording a man whom they could not dispirit, which has been playing at court for near 26 years." Acquitting Mr. Pitt, though he knew that no minister would be very zealous in promoting a man who professed and practiced parliamentary and personal independence, from the charge of forgetting either obligations or connections in the pursuit of his ambition, he lays the blame on a more exalted personage. "As to the king's dislike of me, uncles his education had made him more of a Whig, it was natural enough. My declared opposition to the increased and increasing influence of the crown had made a great impression on his majesty's mind."

Of the bill, introduced into the house of commons by the chancellor of the exchequer in 1808, for making more effectual provision for the maintenance of ripendary curates in England and Wales, and for their relief on their cures, he expressed his disapprobation, with the reason of it, in letters addressed both to the archbishop of Canterbury and Mr. Percival. He rejoiced, however, in the grant of 100,000l. a year by a vote of parliament in 1809, in lieu of queen Anne's bounty; but in his charge of that year, referring to a letter previously written to lord Hawkebury on this occasion, he renewed his complaint of the manner in which he had been neglected, alleging that he never had an equal place of residence amongst his clergy, nor a church-income sufficient to enable him to attend every year his parliamentary duty. Having, in the year 1809, and during an extensive visitation of his diocese, held a confirmation at Merthyr-Tydvil, he was hospitably accommodated at the house of the late Mr. Crawfuir, a well-known iron-founder, whose hospitality the writer of this article has experienced; and before he left the diocese, Mr. C. came to Landaff to take leave of him. On this occasion, taking the bishop by the hand, he said to him, "If ever you have occasion for 5 or 10,000l. it shall be wholly at your service." Of course declining to avail himself of this generous offer, he nevertheless declares, "I was more delighted with this substantial proof of the disinterested approbation of an iron-founder than I should have been with the possession of an arch-bishopric acquired by a selfish subterfude to the delphic principles of a court."

On the subject of Lancastrian schools and bible societies, he declares his opinion to be, "that certain zealous men in the established church have suffered their apprehensions for its safety to outstrip all probability of danger arising from, the institution of either Lancastrian schools or auxiliary bible societies. The church is in no danger from Protestant or Catholic Difenters; but the state must ever be in danger from discontent breeding disaffection, whilst a large portion of its members is looked upon by government with a jealous and repulsive eye." On another occasion, in a letter to Mr. Wyvill, Oct. 21, 1813, he expresses sentiments of a similar kind: "the struggle for the liberty of Europe has been most nobly sustained by Great Britain, and might it not at this period be successfully terminated by our government granting emancipation to the Catholics, and a repeal of the Teft and Corporation acts to the Difenters? These concessions would be more powerful means of defense than all the confcriptions of our enemy can ever be to the contrary." We cannot forbear subjoining a paragraph from Mr. Wyvill's reply: "Mr. Fox proved the sincerity of his attachment to liberty, civil and religious, by the long service of 30 years, almost wholly spent in parliament, under the frown of power: your lordship, I believe, has given a similar proof of your attachment to that belt of caufes. You have endured a similar prostration from men who acted on the same unworthy motives, and the consequence has been almost the fame: you have at Landaff been long flut out from the road to the higher honours of the church. But how much higher have you risen by having obtained the undisputed dignity of virtue, benevolence, patriotism, and the true spirit of Christianity!" Well might the bishop reply to Mr. Wyvill, "I am proud of your honourable testimony to that political confidency of principle, which unites my name to that of Mr. Fox."

From this period the health of the bishop rapidly declined; and though his mental faculties continued unimpaired, yet bodily exercise and literary composition became irksome to him. He expired on the 4th of July, 1816, in the 79th year of his age; illustrating, as the publisher of his Memoirs says, in death the truth of his favourite rule of conduct through life: "Keep innocence, and take heed unto the thing that is right, for that shall bring a man peace at the left."

Having availed ourselves of the work now before us, we make no apology for extending this article beyond the usual limits of our biographical sketches. From the honour of an early acquaintance with the subject of this article, and from a full conviction of his uniform integrity, as well as his pre-eminent talents, we felt a peculiar interest in the perusal of the memoirs of his life. Distinguished by mental powers of a superior order, and by public services which have seldom been paralleled, we pay this tribute of respect to his memory. His character needs no delineation besides the "Anecdotes" which his own pen has furnished. In every department which he occupied, first as a student, and afterwards as a tutor and professor in the university of Cambridge, as a prelate and a member of the legislature, and in the
WATSON, in Geography, a town of Virginia; 35 miles S.W. of Richmond.

WATSON'S Island, an island in the Mergui Archipelago, of an oval form, and about 12 miles in circumference. N. lat. 9° 36'.

WATSONIA, in Botany, was so called by Miller, after the late Sir William Watson, knight, M.D. F.R.S., well known by his numerous papers in the Philosophical Transactions, on many subjects connected with the history of Botany, and eminently distinguished for his cultivation of several branches of philosophical and medical knowledge. Miller's genus being sunk by Linnaeus in Antholyza, the Bittneria was called Watsonia by Boehmer; but the original one, restored by Mr. Ker, is now generally, and with great propriety, adopted.—Mill. 1c. 184. Ker in Sims and Kon. Ann. of Bot. v. 1. 229. Dryand. in Ait. Hort. Kew. v. 1. 93.—Clas and order, Triandria Monogynia. Nat. Ord. Enfate, Linn. Iridis. Juft.

Gen. Ch. Cal. Spatha inferior, shorter than the corolla, of two oblong, close-prefied, permanent valves. Cor. of one petal, superior; tube cylindrical throughout, somewhat enlarged, but not spreading, in the elongated throat, curved; limb nearly regular, in fix deep, flat, spreading, almost equal segments. Stam. Filaments three, inserted into the tube at the origin of the throat, thread-shaped, ascending, shorter than the corolla; anthers oblong, somewhat parallel, incumbent. Pift. Germen inferior, oblong, furrowed; style thread-shaped, longer than the flaminis; stigmas three, slender, deeply cloven, spreading, recurved. Peric. Capsule oblong, bluntly triangular, cartilaginous, of three cells and three valves. Seeds numerous, imbricated downwards, angular in their lower part, dilated into more or less of a wing at the upper end.


This genus differs from Gladiolus in its almost regular corolla, with a cylindrical throat; narrow, divided, not dilated, stigmas; and angular, scarcely winged, seeds. Antilyza, as now limited, is distinguished from it, by having a ringent limb, of unequal and ditiform segments; simple stigmas; and nearly globular seeds. See those articles.

1. W. spicata. Hollow-leaved Watsonia. Ker in Curt. Mag. at p. 553. Ait. n. 1. (Ixia spicata; Wildl. Sp. Pl. v. 1. 200. I. cepaces; Redout. Liliac. t. 96. I. filifula; Curt. Mag. t. 533. I. alopecuroidea; Linn. Suppl. 92. Gladiolus spicatus; Linn. Sp. Pl. 53. Thunb. Gladiol. n. 13. G. filifulus; Jacobs. Hort. Schoenbr. v. 1. 8. t. 16.)—Leaves cylindrical, hollow.—Gathered by Thunberg, on the highest hills of Hottentot's Holland, at the Cape of Good Hope, flowering in December and January. By Sir Joseph Banks's herbarium, this species appears to have been cultivated by Mr. W. Malcolm, in 1791. It blooms in the European green-houses in May, but not very readily, often bearing small out-like bulbs in the place of flowers. The bulb is small, round, with a fibrous coat. Stem leafy, from eight to twelve inches high. Leaves alternate, very remarkable for their cylindrical inflated form, gradually swelling upwards, obtuse, with a small point; their surface very smooth; their base sheathing. Flowers either light blue or pale purple, very numerous, closely imbricated in a two-ranked tapering spike, with reddish crenate sheaths. Corolla regular, expanding rather more than half an inch. We do not find that the stigmas of this plant are closed, as the generic character requires, and we should have left it in Ixia, till it could otherwise have been disposed of. The same remark applies to the following. The name spicata is not so exclusively appropriate as filifula or cepaces would have been, but it is the oldest name, and liable to no objection. This is certainly, as far as we can make out, the original Gladiolus spicatus of LINNAEUS, though he, long after its publication, very inadvertently laid into his herbarium, under that name, a Siberian specimen of a small-flowered variety of Gl. communis.

2. W. plantaginacea. Plantain-spike Watsonia. Ker in Curt. Mag. t. 553. Ait. n. 2. (Ixia plantaginacea; Wildl. Sp. Pl. v. 1. 200. Gladiolus alopecuroidea; Linn. Suppl. Pl. 54. Amon. Acad. v. 4. 301. Thunb. Gladiol. n. 14.)—Upper leaves liniar-fword-shaped, many-ribbed: lowermost hollow, compressed. Flowers imbricated in two rows.—Gathered by Thunberg in several places near the town, at the Cape of Good Hope, often in the highways. This differs esseniially from the species just described, in having the usual sword-shaped foliage of its natural order. Their flowers nearly resemble each other. These are in the present species either blue or white, very numerous, forming a dense two-ranked spike, with membranous-edged sheaths, recalling the idea of some kind of Plantain. Sometimes each flowe bears two or three flesh fpikes, which are then very large and luxuriant; but in our cultivated specimens they are usually solitary, as well as much smaller. The flowers are without seert.

WATSONIA.

6. W. brevifolia. Short-leaved Watsonia. Ker in Curt. Mag. t. 601. Ait. n. 6. (Antholyza spicata; Andr. Repof. t. 56. Gladiolus teffaceus; Vahl Enum. v. 2. 105.)—Leaves ovate-fword-shaped, equitant, very short. Tube, throat, and limb, of the corolla equal in length; mouth naked.—Native of the Cape of Good Hope, from whence it was imported by W. Miller, Lee and Kennedy, through the hands of Mr. Pringle of Madeira, in 1794. The leaves are about four, almost perfectly radical, remarkable for their thornets, being but two or three inches long, though near an inch wide; their edges cartilaginous, though very narrow. Stem twelve or eighteen inches high. Spike long, erect, simple, or sometimes branched, but not composed of little spikelets. Flowers of a tawny red, about the size of W. marginata, but the proportion of their tube, and especially their throat, is longer compared with the limb. Their colour would lead us to expect some fragrance, in the evening at least, but this is said not to be the case. They have, however, the advantage of being much more lasting than some of their allies. The figmas are deeply cloven.

7. W. iridifolia. Flag-leaved Watsonia. Ker in Ann. of Bot. n. 12. Ait. n. 7. (Gladiolus iridifolius; Jacq. f. 1. 1803. Illid. Sp. Pl. t. 234. Wildl. Sp. Pl. v. 1. 217, excluding the synonym G. cardinals.)—2. var. fulgens; Curt. Mag. t. 600. (Antholyza fulgens; Andr. Repof. t. 192. Gladiolus marginatus; Thunb. Gladiol. n. 20.)—Throat of the corolla curved, longer than the tube, and rather longer than the acute limb. Leaves sword-shaped, erect, with a prominent midrib.—Native of the Cape of Good Hope, from whence it was sent by Mr. Maffon, in 1795. The variety is preferred, on account of the splendiferous red of its flowers, in which alone it is said to differ from the pale green-yellow-planted, by Jacquin. We have not seen the latter, but if the figure be correct, the tube, and the cylindrical throat, are, each of them, shorter in proportion to the flower, and to the limb, than in the scarlet kind. The leaves in both are long, erect, and finely divided at the edges, having more of a midrib than the several foregoing species. The species, in the scarlet variety, are not much above half the length of the slender tube, which is about two-thirds as long as the greatly-extended, cylindrical, curved, and strongly deflexed throat. The latter exceeds the length of the elliptical, acute, recurved, nearly equal, segments of the limb. Antthers violet. Stigma cloven half way down, divaricated.


9. W. humilis. Crimson Watsonia. Mill. f. c. 297. f. 2. Ker in Curt. Mag. t. 631. 1195. Ait. n. 9. (Gladiolus lacceatus; Jacq. f. 1. 1803. Curt. Mag. t. 232. Wildl. Sp. Pl. v. 1. 215.)—Throat of the corolla curved, rather longer than the acute limb; tube the length of the spatha. Leaves sword-shaped, erect, with a prominent midrib.—Native of the Cape of Good Hope, from whence the seeds were obtained by Miller, in 1754. Much smaller than several of the last described, being seldom above a foot high.
high, with linear leaves. The flowers are of a crimson, or rofe-coloured, hue, not verging towards a fcarlet, or tawny red. They vary in fize, as may be seen by the two figures in the Botanical Magazine. The throat is correctly cylin-
drical; tube generally shorter than the fpatha, not longer. We are obliged to content ourselves with the above specific charaters, founded on the proportion of thefe parts, for want of better. Mr. Ker and Mr. Dryander have done much towards the correct discriminatian of genera and spec-
cies in this favourite tribe, but the fubject is far from being exhausted.

albus; Jacq. Hort. Schoenbr. v. 1. t. 13. Vahl Enum. v. 2. 93.)

β. Variegated with red. Ker in Curt. Mag. t. 1193. Ait. Epit. 376. — Tube about twice the length of the throat, limb, or fpatha, making nearly a right angle with the throat. Leaves fword-shaped, with a midrib. — Native of the Cape of Good Hope. The tube is one or two inches long, erect; throat suddenly deflexed, cylin-
drical, rather flender, an inch long; segments of the limb lancel-
olate, acute, the length of the throat. Anthers but juf
projecting out of the mouth of the flower, violet-coloured. Stigmas in linear segments. The corolla is either cream-
coloured, with rofe-coloured tints about the mouth and throat, or fleft-coloured blotched with fcarlet, or all over crimson. The flowers are more numerous and crowded than in W. Meriana and its allies. We cannot doubt the diffinctions of this species.

olus tubulosus; Jacq. Ic. Rar. t. 229. Antholyza tubu-
losa; Andr. Repof. t. 174. A. Merianaell; Curt. Mag. t. 441, excluding the reference to Miller.) — Throat de-
flected, four times as long as the segments of the limb.
— Found at the Cape of Good Hope by Mr. Maffon, who sent bulbs to Kew garden in 1774. This elegant species bears numerous drooping flowers, of a rich crimson, some-
times fpeckled with a darker tint, or with white, and re-
markable for their small flightly-spreadin limbs, fo fhort in proportion to the long tubular deflexed throat, that they re-
semble the flowers of an Alcetis or Alce. The leaves are fword-shaped, narrow, with a central rib not very strongly marked, and feveral fmal lateral ones.

shaped, twice the length of the fpatha; throat erect, very short, flightly dilated; segments of the limb elliptical,
obtufe, half the length of the tube. Leaves fword-shaped, with a prominent midrib. — Native of the Cape of Good Hope, from whence it was imported by the honourable W. Herbert. The fstem is about twelve or eighteen inches high, with several fhortifh taper-pointed leaves at the bottom, and bears about two handfome crimson flowers, reSembling fome of the larger fæcata, in the shape, fize, and posture of the limb, with a very long ftraiten tube. Stigmas divided, as in true Watfonia, the only charater in which this plant answers to the genus. On the contrary, Gladi-
LUS.) has every charater and appearance of a Wat-
fonia, even a regular flower, except the narrow deeply cloven sfigmas. We are obliged, therefore, to confefs, that these gen-
ers do not at prefent reft on any natural distinction, how-
ever different fome of their species may be from each other.

WAT-TEAUMENUE, or St. Peter, in Geography, a river of North America, which runs into the Missi-
ippi, N. lat. 44° 42'. W. long. 96° 38'.

WATTEAU, Anthony, in Biography, one of the moft
agreeable painters of the French school, was born at Val-
ciennes in 1684. His parents were in indigent circumstances,
and he was placed with an obscure artist in his native city, to
cultivate a talent which manifested itself early. When he
was about 16 years old, having already surpassed his preceptor,
he connected himself with a scene-painter on his way to Paris,
and for some time affifted his associate in decorating the
opera-houfe in that city. When this engagement was com-
pleted Watteau found it difficult to refuse himself from the
obscenity and embarrassment into which he fell, when happily
he became acquainted with Claude Gillot, a painter of ge-
tegue and fabulous subjects, who was pleased with his
works and disposition. Gillot afforded him an asylum in his
own house, and then inftucted him in all he knew of the art,
and found an apt and agreeable scholar in his protegée. With
the help he thus received from Gillot, and his own admiration
and attentive study of the Luxembourg gallery, he formed a
tafte for colouring, which if not as grand, is at least as agree-
able, as ever was employed by any one.

He attempted to prepare himself for historical painting,
and studied at the academy with that view; he even was fo
successful as to obtain the first prize there for an historical
picture; but happily he discovered a character of subject quite
original and exactly suited to his talent, for which he wisely
deflected history, and which has since formed plenty of aspir-
ants, but has never been so successfully prafified. The
theatre, the opera, fêtes champéprech, masquerades, pantom-
imes, puppet-shows, afforded him his figures; the gardens
of the Luxembourg and of the Thilleries, of Verfailles and
St. Cloud, furnished the scenes. In these nature prevails
only in the colouring, and that is exquisite, rich, delicate,
clear, and full; bright without gaudines, and deep without
blacknes; laid on with a freedom, fulnes, and delicacy of
touch, which no one ever surpassed; but the airs of his
figures are generally affected to the highst degree; people of
rank and fashion, aping the enjoyments of rural life; and
when he attempted to paint domestic or rural scenes, he
carried the fame tale into his practice. The true charac-
ter of Watteau's pictures is French gentility, gay, cheerful,
debonnaire, of which self-satisfaction is the chief bals.

"In his hals and marches of cavalry, the careless frunt
of his soldiers retains the air of a nation that aspires to be
agreeable as well as victorious." Watteau visited England
in the reign of George 1., but did not enjoy his health here,
and returned to France in about a year, where he died in 1721,
at the early age of 37.

WATTEN, in Geography, a town in Scotland, in the
county of Caithness; 7 miles N.W. of Wick. — Also, a
town of France, in the department of the North, on the
Aa; 4 miles N. of St. Omer.

WATTENFISCH, a town of Germany, in the county of
Mark; 5 miles S.W. of Bockum.

WATTER, a river which rises in the county of Wal-
deck, and runs into the Erpe, near Voleckmarfen.

WATERPUTTEN, a town of Hindoostan, in Con-
can; 5 miles S. of Geriah.

WATTINAD, a town of Hindoostan, in the Carnatic;
20 miles S.S.E. of Tanjore.

WATTLE, in Agriculture and Rural Economy, a kind of
hurdle formed by means of split wood, or small rods, and
used for making folds for sheep. The term also signifies a
flefy excrecence growing from under the top of the throats

Vol. XXXVIII.
of animals, such as the cock, turkey, and some others. See Hurdle.

WATTLE-BIRD. See Glaucus Cinerus.

Wattles, in Rural Economy, a term applied, in some places, to the rods that are laid upon a roof to be thatched on. This is found an useful and cheap mode for farm buildings in some of the southern districts. See Thatching.

WATTON, in Geography, a small market-town in the hundred of Wayland and county of Norfolk, England, is situated on the confines of what is called the Filand, or open part of the county, at the distance of 21 miles W. by S. from Norwich, and 91 miles N.E. from London. Since the making of the turnpike-road through the hundred, Watton has become a place of considerable thoroughfare. It has three annual fairs, and a respectable weekly market on Wednesdays.

Great quantities of butter are sent hence for the supply of the London markets. In the enumeration of the population for the year 1811, the parish was stated to contain 177 houses, with a population of 794 persons. The church is very small, being only twenty yards long and eleven broad: the tower is round at the bottom, and octagonal at the top. Blomefield was induced, from the appearance of the church, to suppose it was erected so early as the reign of Henry I. It stands at a distance from the town, near the site of the old manorial house; and was evidently so placed to accommodate the tenants of the several hamlets belonging to the manor. On the 25th of April 1673, a dreadful fire happened in the town, when above sixty houses were burnt down, besides out-houses, &c. to the damage of 745l., and goods to the further value of 2660l.: for which a brief was granted to collect throughout England for two years.—Blomefield's Effay towards a Topographical History of Norfolk, vol. 2. 8vo. 1805. Beauties of England and Wales, vol. xi. Norfolk. By Rev. J. Evans, and J. Britton, F.S.A.

WATTS, ISAAC, D.D. in Biography, a Nonconformist divine, eminently distinguished for talents and piety, was born at Southampton in 1674, where, under the tuition of a clergyman of the established church, he made rapid progress in the Latin and Greek languages, and acquired some knowledge even of Hebrew. When it was proposed by some gentlemen who were apprized of his proficiency, to bear the charges of his education in one of the English universities, he declined his purpose of continuing among the Dissenters, though his father, who was of that profession, had often suffered persecution; and at the age of sixteen he was placed under the care of the Rev. Thomas Rowe, who kept an academy in London. Twenty-two Latin dissertations on metaphysical and theological subjects, found among his papers, afford ample evidence of his zealous application during his connection with this institution. Of his poetical talents at the early age of fifteen years several specimens have been preserved, and more particularly a Pindaric ode, addressed to his preceptor Mr. Pinhorn. At the age of twenty he finished his academical studies, and refixed with his father for two years with a view to farther improvement. At this time he was invited to become private tutor to the son of Sir John Hartopp, bart. at Stoke-Newington near London, and in this situation he continued for five years, gaining universal esteem, cultivating a friendship with his pupils which lasted through life, and connecting with the discharge of his office the study of the scriptures in the original languages. Although he was well qualified for the public exercise of his ministry, such was his diffidence that he would not venture to ascend the pulpit till he had completed his twenty-fourth year, at which time he was chosen assistant to Dr. Isaac Chauncy, whom he succeeded as pastor in the year 1702. His constitution was so delicate that he could not undertake the whole service, and the attack of a fever in 1712 disqualified him for his public duties for four years. In this state of debility he was kindly received in the house of Sir Thomas Abney, where the indulgent treatment of this gentleman and his lady contributed to restore his health and spirits. In this hopitable situation he not only found a temporary asylum, but a permanent abode for the remaining thirty-six years of his life. Here he enjoyed every comfort which friendship and liberality could bestow, and which, by repairing his enfeebled frame, enabled him to resume his services in public and to prosecute his private studies, no less to the improvement and satisfaction of those with whom he was immediately connected, than to the beneficence of the world; infomuch that few persons have acquired a more extensive and a more permanent popularity, as it respects the interests both of literature and of religion. His reputation attracted the notice of both the universities of Edinburgh and Aberdeen, and they seemed to vie with each other which would first confer upon him the honour of the degree of doctor in divinity, and he received it from these two universities in the year 1728. His constitution, though in some degree renovated by the attention and kindness which he experienced, was still too delicate and feeble, that he found it necessary to remit, and at length to resign his ministerial duties; but his congregation testified their respect for him by declining to accept his offer of the renunciation of his usual salary. However, he gradually declined, and calmly expired at Stoke Newington, November the 25th, 1748, in the 75th year of his age.

Dr. Watts was a man of lively fancy, warm feelings, and a comprehensive understanding, and distinguished by that veracity of talents and pursuits, which enabled him to acquire a considerable degree of reputation in various departments of literature, but which prevented his arriving at a supereminent rank in any. The characteristical quality of his mind, manifested in his numerous productions, was a devotional spirit. Of his "Hymns," the greatest number belong to the devotional class, and in these his ardent feelings and imagination have sometimes transported him beyond the bounds which a correct taste and sound judgment would have preferred. The same observation may be also applied to his "Psalms and Hymns," and more especially to the latter, which were juvenile compositions, and in which a sober reader will be disquieted with the contrast that is exhibited between the wrath of the Supreme Being and the benignity of the Son of God; as if the Deity were inclined to punish his offending creatures with everlasting punishment, and the Son were disposed to rescure and save them. Many of the psalms and hymns, however, are admirably adapted to Christian worship, and a select collection of them, which has been lately made by some ministers in London, and which they have enriched by extracts from other sources, is least exceptions in a variety of respects than either the psalms or hymns even of Dr. Watts in their original state; and in the devotion and poetry are more happily combined for the worship of Dissenters and even of Churchmen than in the psalms of the establishment. Many of Watts's lyrical productions poise a considerable poetical merit, and display a fertility and elegance of fancy. His "Divine Songs for Children" have been widely circulated, and are well calculated to interest and impress youthful minds; and they are, generally speaking, unexceptionable, though not incapable of correction and improvement.

The doctor's philosophical publications are numerous, and most of them are well known. Among these we may reckon his "Logic," and the supplement to it, entitled the "Improvement of the Mind;" "A Discourse on Education;" "An Elementary Treatise on Astronomy and Geography;" and "Philoso-
Philosophical Essays on various Subjects, with Remarks on Locke's Essay on the Human Understanding;” and "A brief Scheme of Ontology.” His other works are chiefly theological, containing Sermons, Difcourses, Essays, and Controversial Tracts, &c. His scheme of theology was undoubtedly that which is usually called orthodoxy, and, to lay the leaf at it, approaching to Calvinism. His temper, however, was kind and gentle, and his moderation was increasing as he advanced in years, and the maturity of his judgment restrained and controlled the fervour of his feelings and passions. Some have said that towards the close of life his sentiments, with regard to the doctrine of the Trinity, were materially altered. This, however, is a question judicis. Whilst it is needless in this place to enter into the dispute, and to examine the allegations pro and con, we incline to think, as far as we have had an opportunity of examining the evidence, that the supposition of some degree of change is not improbable. The printed Works of Dr. Watts, together with those which were left in M.S. for the revision of Dr. Jennings and Dr. Doddridge, were published collectively by Dr. Gibbons, in 6 vols. 1754. We shall conclude this article with the words of one of his biographers. “To whatever class Dr. Watts belongs,” said this biographer among the decided advocates for orthodoxy, “he must always be regarded as one of those whose whole heart was devoted to the promotion of the best interests of mankind, and whose life would have done honour to any system of opinions.”


WAVES, in Geography, a town of Virginia; 30 miles N.W. of Alexandria.—Alfo, a town of the state of Georgia. N. lat. 34° 22’. W. long. 86° 25’.

WATTS ISLAND, a small island in the Cheapeak. N. lat. 37° 54’. W. long. 76° 3’.

WATTESKIFLET, a channel of the Baltic, between the ifland of Aaland and the coast of Finland, abounding with small iflands.

WATREILER, or Watterweiler, a town of France, in the department of the Upper Rhine. Near it is a medicinal spring; 16 miles S. of Colmar.

WAU, a town of Hindooflan, in the cercle of Werrebar; 24 miles N. of Radanpour.

WAU-CA-HATCHO, or Cow-Tail River, a river of Louisiana, which is the left stream of any iflands that enters the Sabine.

WAVES, UNDA, in Physics, a cavity in the surface of the water, or other fluid, with an elevation on its fides. Or, it is a volume of water elevated by the action of the wind upon its surface, into a state of fluctuation.

The origin of waves may be thus conceived. The surface of a standing water being naturally plain, and parallel to the horizon, (allowing for that small degree of curvature which results from its gravitation to the centre,) if by any means it be rendered hollow, as at A, (Plate XV. Hydrostatics, fig. 11.) its cavity will be surrounded with an elevation B B; for if a certain quantity of water be deprefled below the usual level, an equal quantity must rife in some other place above that level, and the water which stands elfewhere to the place of the original imprefion will of course be moved. The raised water will difcend by its gravity, and, with the celerity acquired in defcending, will form a new cavity; by which motions, the water will ascend at the fides of this cavity, and fill the cavity A, while there is a new elevation towards C; and, when this laft is deprefled, the water rifes anew towards the fame part. Thus arifes a sucessive motion in the surface of the water; and a cavity, which carries an elevation before it, is moved along from A, towards C. Thus the alternate rising and falling of the water in ridges will extend all round the original fource of motion; but as they recede from that place, fo the ridges, as well as the adjoining hollows, become smaller and smaller, until they vanifh. This diminution of size is produced by three fpecies; viz. by the want of perfect freedom of motion amongst the particles of water, by the refiftance of the air, and by the further ridges being larger in diameter than thofe which are nearer. It is likewife on account of the friction, or adhesion, among the particles of water, and of the refi- stance of the air, that, in the fame place, the alternate elevations and depreffions diminifh gradually, until the water re-affumes its original tranquillity, unlefs the external imprefion be renewed or continued. This cavity, with the elevation next it, is called a wave; and the space taken up by the wave on the surface of the water, and meafured according to the direéion of the wave’s motion, is called the breadth of the wave; which is evidently equal to the dif- tance between the tops of contiguous ridges, or between the lowest parts of two contiguous hollows; and a wave is faid to have run its breadth, when its elevated part is arrived at the place where the elevated part of the next wave flood before, or (the situations of two contiguous waves being given) when one of them is arrived at the place of the other; and the time which is employed in this transiton is called the time of a wave’s motion.

WAVES, the Motion of, forms an article in the new philosophy; and its laws being now pretty well determined, we fhall give the reader the fubifterance of what is taught on this fubject.

1. The cavity, as A, is encompassed every way with an elevation; and the motion above-mentioned expands itself every way: therefore the waves are moved circularly.

2. Suppose, now, A B (fig. 12.) an obficle, againft which the wave, whose beginning is at C, strikes; and we are to examine what change the wave suffers in any point, as E, when it is come to the obficle in that point. In all places through which the wave paffes in its whole breadth, the wave is railed; then a cavity is formed, which is again filled up; which change while the surface of the water undergoes, its particles go and return through a small space: the direéion of this motion is along C E, and the celerity may be reprefented by that line. Let this motion be contrived to be resolved into two other motions, along G E and D E, whose celerities are reprefently reprefented by those lines. By the motion along D E, the particles do not act against the obficle; but, after the stroke, continue their motion in that direéion with the fame celerity; and this motion is here reprefented by E F, supposing E F and E D to be equal to one another; but by the motion along G E, the particles strike directly againft the obficle, and this motion is defroyed: for though the particles are elastic, yet, as in the motion of the waves they run through but a small space, going backward and forward, they proceed fo slowly, that the figure of the particles cannot be changed by the blow; and fo are fubject to the laws of perceffion of bodies perfectly hard. See Percussion.

But there is a reflection of the particles from another obficle: the water which cannot go forward beyond the obficle, and is pushed on by that which follows it, gives way where there is the leaft refiftance; that is, it affconds; and this elevation, which is greater in fome than other places, is caused by the motion along G E; because it is by that motion alone that the particles impinge against the obficle. The water, by its affcond, acquires the fame velocity with which it was railed; and the particles of water are repelled from the obficle with the fame force in the direéion E G,
WAVES.

as that with which they struck against the obstacle. From this motion, and the motion above-mentioned along $E F$, arises a motion along $E H$, whose celerity is expressed by the line $E H$, which is equal to the line $C E$; and by the reflection, the celerity of the wave is not changed, but it returns along $E H$, in the same manner as if, taking away the obstacle, it had moved along $E b$.

If from the point $C$, $C D$ be drawn perpendicular to the obstacle, and then produced, so that $D C$ shall be equal to $C D$, the line $H E$ continued will go through $D$; and as this demonstration holds good in all points of the obstacle, it follows, that the reflected wave has the same figure on that side of the obstacle, as it would have had beyond the line $A B$, if it had not struck against the obstacle. If the obstacle be inclined to the horizon, the water rises and descends upon it, and suffers a friction, by which the reflection of the wave is disturbed, and often wholly destroyed; and this is the reason why very often the banks of rivers do not reflect the waves.

If there be a hole, as $I$, in the obstacle $B L$, the part of the wave which goes through the hole, continues its motion directly, and expands itself towards $Q Q$; and there is a new wave formed, which moves in a semicircle, whose centre is the hole. For the raised part of the wave, which first goes through the hole, immediately flows down a little at the sides; and, by descending, makes a cavity which is surrounded with an elevation on every part beyond the hole, which moves every way in the same manner as was laid down in the generation of the first wave.

In the same manner, a wave to which an obstacle, as $A O$, is opposed, continues to move between $O$ and $N$, but expands itself towards $R$, in a part of a circle, whose centre is not very far from $O$. Hence, we may easily deduce what must be the motion of a wave behind an obstacle, as $M N$.

Waves are often produced by the motion of a tumultuous body, which also expand themselves circularly, though the body goes and returns in a right line; for the water which is raised by the agitation, descending, forms a cavity, which is everywhere surrounded with a railing.

Different waves do not disturb one another, when they move according to different directions. The reason is, that whatever figure the surface of the water has acquired by the motion of the waves, there may in that be an elevation and depression; as also such a motion as is required in the motion of a wave.

To determine the celerity of the waves, another motion, analogous to their's, must be examined. Suppose a fluid in the bent cylindric tube $E H$ (fig. 13.); and let the fluid in the leg $E F$ be higher than in the other leg by the distance $I E$; which distance is to be divided into two equal parts at $I$. The fluid, by its gravity, descends in the leg $E F$, while it ascends equally in the leg $G H$; so that when the surface of the fluid is arrived at $I$, it is at the same height in both legs; which is the only position in which the liquid can be at rest: but by the celerity acquired in descending, it continues its motion, and ascends higher in the tube $G H$; and in $E F$ is depressed quite to $I$, except so much as it is hindered by the friction against the sides of the tube. The fluid in the tube $G H$, which is higher, also descends by its gravity, and so the fluid in the tube rises and falls, till it has lost all its motion by the friction.

The quantity of matter to be moved is the whole fluid in the tube; the moving force is the weight of the column $E F$, whose height is always double the distance $E I$; which distance, therefore, increases and diminishes in the same ratio with the moving force. But the distance $E I$ is the space to be run through by the fluid, in order to its moving from the position $E H$, to the position of rest; which space, therefore, is always the force continually acting upon the fluid; but it is demonstrated, that it is on this account that all the vibrations of a pendulum, oscillating in a cycloid, are isochronal; and, therefore, here also, whatever be the inequality of the agitations, the fluid always goes and returns in the same time. The time in which a fluid thus agitated ascends, or descends, is the time in which a pendulum vibrates, whose length is equal to half the length of the fluid in the tube, or to half the sum of the lines $E F$, $F G$, $E H$. This length is to be measured in the axis of the tube. See PENDULUM.

From these principles, to determine the celerity of the waves, we must consider several equal waves following one another immediately; as $A$, $B$, $C$, $D$, $E$, $F$, (fig. 14.) which move from $A$ towards $F$: the wave $A$ has run its breadth, when the cavity $A$ is come to $C$; which cannot be, unless the water at $C$ ascends to the height of the top of the wave, and again descends to the depth $C$; in which motion, the water is not agitated sensibly below the line $b i$: therefore, this motion agrees with the motion in the tube above-mentioned; and the water ascends and descends, that is, the wave goes through its breadth, while a pendulum of the length of half $B C$ performs two oscillations, or while a pendulum of the length $B D$, that is, four times as long as the first, performs one vibration; since the times in which pendulums of different lengths perform their vibrations are as the squares of their lengths. (See Vibration.) Therefore, the celerity of the wave depends upon the length of the line $B D$; which is greater, as the breadth of the wave is greater, and as the water descends deeper in the motion of the waves. In the broadest waves, which do not rise high, such a line as $B D$ does not much differ from the breadth of the wave; and in that case a wave moves its breadth, while a pendulum, equal to that wave, oscillates once. Hence, if the breadth of a wave be $39.1196$ inches, (this being the length of a pendulum which vibrates seconds,) then that wave will move on at the rate of $39.1196$ inches per second of time; that is, at the rate of $195$ feet per minute, nearly.

In every equable motion, the space gone through increases with the time and the celerity; wherefore, multiplying the time by the celerity, you have the space gone through; whence it follows, that the celerities of the waves are as the square roots of their breadths; for as the times in which they go through their breadths are in that ratio, the same ratio is required in their celerities, that the products of the times, by their celerities, may be as the breadths of the waves, which are the spaces gone through.

Dr. Young is of opinion, that sir Isaac Newton's analogy, resulting from a comparison of a wave with the oscillation of a fluid in a bent tube, is too distant to admit our founding any demonstration upon it. Lagrange, he says, has investigated the motions of waves in a new and improved manner; and Dr. Young has also demonstrated a theorem similar to his, but, as he apprehends, more general and explicit. From these premises it appears, that, supposing the fluids concerned to be infinitely elastic, that is, absolutely incompressible, and free from friction of all kinds, any small impulse communicated to a fluid would be transmitted every way along its surface, with a velocity equal to that which a heavy body would acquire in falling through half the depth of the fluid; and he concludes, from observation and experiment, that where the elevation or depression of the surface is considerably extensive in proportion to the depth, the velocity approaches nearly to that which is thus determined.
WAVES.

Count Marigh measured carefully the elevations of the waves near Provence, and found that, in a very violent tempest, they arose only to seven feet above the natural level of the sea; and this additional foot in height, above the result of Mr. Boyle’s deductions, he easily resolved into the accidental shocks of the water against the bottom, which, in the place he measured them in, not so deep as to be out of the way of affecting those waves; and he allows that the addition of one-sixth of the height of a wave, from such a disturbance from the bottom, is a very moderate alteration from what would have been its height in a deep sea; and concludes, that Mr. Boyle’s calculation holds perfectly right in deep seas, where the waves are purely natural, and have no accidental causes to render them larger than their just proportion.

In deep water, under the high shores of the same part of France, this author found the natural elevation of the waves to be only five feet; but he found also that their breaking against rocks, and other accidents to which they were liable in this place, often raised them to eight feet high.

We are not to suppose, from this calculation, that no wave of the sea can rise more than six feet above its natural level in open and deep water; for waves immensely higher than these are formed in violent tempests in the great seas. These, however, are not to be accounted waves in their natural state, but they are singular waves formed of many others; for in these wide plains of water, when one wave is raised by the wind, and would elevate itself up to the exact height of six feet, and no more, the motion of the water is so great, and the succession of waves so quick, that during the time this is rising, it receives into it several other waves, each of which would have been at the same height with itself; these run into the first wave one after the other, as it is rising; and by this means its rise is continued much longer than it naturally would have been, and it becomes accumulated to an enormous size. A number of these complicated waves arising together, and being continued in a long succession by the continuation of the form, makes the waves so dangerous to ships, which the sailors in their phrase call mountains high. Marigh, Hist. Phyf. de la Mer.

When it blows fresh, the waves not moving with sufficient rapidity, their tops, which are thinner and lighter, are impelled forward, broken, and changed into a white foam, particles of which, called the “spray,” are carried a great way. Waves, with regard to their form, are circular or straight, or otherwise bent, according as the original impression is made in a narrow space nearly circular, or in a straight line, or in other configurations. In open seas the waves generally are in the shape of straight furrows, because the wind blows upon the water in a parallel manner, or at least for a long apparent tract. The same causes which raise water into waves must evidently produce the like effect on other fluids, but in various degrees, as the fluid is more or less heavy, as its particles adhere more or less forcibly to each other, and probably likewise as there is a greater or less degree of attraction between the fluid and the other body which gives it the impulse. If it be attempted to raise waves upon oil by the force of wind, it will be found very difficult to succeed in a similar degree. This difficulty is probably owing to the natural attraction of the particles of oil; and besides, there may be less attraction between oil and air than between the latter and water, for water always contains a certain quantity of air; and if it be deprived of that air by boiling, or otherwise, a short exposure to the atmosphere will enable the water to reimburse it. It is likewise probable, that the surface of water, even when flag-
WAVELLITE, in Mineralogy, a mineral first discovered at Barnstaple, in Devonshire, by Dr. Wavell, and hence found in various other situations. From its appearance, it has been claffed by Mr. Jamefon as a member of the zeolite family. See Zeolite.

Wavellite occurs in a botryoidal, stalactical, and globular form; also crystallized in very oblique four-fided prisms, flatly bevelled on the extremities: the bevelling planes are set on the obtuse lateral edges. The prisms are sometimes deeply truncated on the obtuse lateral edges. Wavellite occurs also in fibres, or acicular prisms, diverging from a common centre, and either separated or adhering laterally to each other, composing hemispherical concretions of various sizes, to the magnitude of a bullet. The lustre of wavellite is pearly, more or less shining. The colour is yellowish-white, greyish-white, and greenish-white; it is translucent. This mineral is brittle, and, according to professor Jamefon, it is sufficiently hard to scratch quartz: others ascribe to it a lower degree of hardnes. Before the blow-pipe it becomes soft and opaque, but neither decomposes nor fuses. It is soluble by the affifiance of heat in the mineral acids, in which it effervesces and leaves very little residue. The specific gravity of wavellite varies from 2.22 to 2.70.

The most remarkable peculiarity of this mineral is its composition; wavellite being nearly a pure hydrat of alumine; but some specimens contain a trace of fluoric acid. When fragments of the English or Irish wavellite are laid upon a glasses plate, and a drop of sulphuric acid is added, the glasses is slightly corroded on the application of heat, indicating the presence of the above-mentioned acid.

The constituent parts of wavellite are given as under:

<table>
<thead>
<tr>
<th></th>
<th>Proportion</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alumine</td>
<td>71.50</td>
<td>70</td>
</tr>
<tr>
<td>Oxyd of iron</td>
<td>1.50</td>
<td></td>
</tr>
<tr>
<td>Lime</td>
<td>28.</td>
<td>26.2</td>
</tr>
<tr>
<td>Water</td>
<td>97.6</td>
<td>Davy</td>
</tr>
</tbody>
</table>

**WAVELITE from Barnstaple.**

South American Wavellite.

<table>
<thead>
<tr>
<th></th>
<th>Proportion</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alumine</td>
<td>58.70</td>
<td>68</td>
</tr>
<tr>
<td>Oxyd of iron</td>
<td>0.19</td>
<td></td>
</tr>
<tr>
<td>Lime</td>
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<td></td>
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<tr>
<td>Silex</td>
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<tr>
<td>Water</td>
<td>30.75</td>
<td></td>
</tr>
<tr>
<td>Lofs</td>
<td>3.87</td>
<td></td>
</tr>
</tbody>
</table>

**100 Klaproth. 100 Gregor.**

Wavellite occurs in veins in the granite of Cornwall, with fluor-fpar, quartz, tin-flone, and copper pyrites. At Barnstaple, in Devonshire, it occurs in soft flake. Several mineralogists consider wavellite as a variety of the same mineral, which Haury has called diasprope.

WAVENY, in Geography, a river of England, in the county of Suffolk, which joins the Yare, at its mouth.

WAVEREN, a town of France, in the department of the Scheld, on the Dyle. By war and accidental fires much decayed; 12 miles S. of Louvain.

WAVERS, in Rural Economy, a term used to signify the young timber-trees, or timberings as they are mostly called, that are left standing for further growth, in felling or cutting over woods of different kinds. See Timber.

WAVESON, in the Admiralty-Law, a term used for such goods, as, after shipwreck, appear swimming on the waves.

WAVIGNIES, in Geography, a town of France, in the department of the Oise; 10 miles N. of Clermont.

WAUKEAGUE, a town of the district of Maine, near the coast; 5 miles W. of New Britof.

WAUNGLY, a town of Hindooflan, in Vifapour; 10 miles S.E. of Currer.

WAVY, in Botany, is synonymous with repandum undulatum; in the firft instance, it exprefles an undulating outline, with an even surface; in the second, an undulating surface, caufed by the marginal region of a leaf, or petal, being more ample or luxuriant than the central part, or bafe. The latter is often the cafe with cultivated plants, as Malva crispa, and the different curled varieties of cabbage, broccoli, parley, mint, &c.

Wavy, in Heraldry. See Waved.

WAWAY, in Geography, a small ifland in the East Indian sea, near the E. coast of the ifland of Celebes, about 40 miles in circumference. S. lat. 4° 8'. E. long. 123° 30'.

WAWARING, a large township of New York, in the south-west angle of Ulster county, 25 miles S.W. of Kingston, erected in 1806, from the S.W. part of Rochester, and lying on the W. of the Shawangunk mountain. Pumulo, of a good quality, is found in this township, and here are many indications of iron-ore. Here are several small settlements, as at Warwaging, Napanagh, and Lurencill; but much of the land is uncultivated. Here are one Dutch reformed church, and eight or ten school-houses. In 1812, the whole population confifted of 1335 perons, and the number of electors was 117; and here were 74 looms in families, which produced 18,047 yards of cloth.

WAWIACHTANOS, Indians of America, inhabiting chiefly between the rivers Wabaft and Sciota.

WAWRA, a small negro town of Africa, properly belonging to Kaarta, but when Park vifited it, tributary to Maafong, king of Bambarra. It is surrounded with walls, and inhabited by a mixture of Mandingoes and Foulahs. The inhabitants are chiefly employed in cultivating corn, which they
they exchange with the Moors for salt; 60 miles E.S.E. of Benown.

WAX, a term which comprehends two or three substances, differing in their nature and origin, and yet possessing several common properties. The common properties of the animal and vegetable productions, of which we shall give a brief account in the sequel of this article, are fusibility at a moderate heat; when kindled, burning with much flame; insolubility in water; solubility in alkalies, and also in alcohol and ether; in which two latter properties all the species of wax differ from the concrete oils, to which in other respects they bear a very strong resemblance. The most important, and most generally known and used of these substances, is

Bees'-wax, excreted from the body of the bee, and employed by these insects in the construction of their cells, both for the accommodation of their young and the deposition of their honey. Of this substance, a young hive will yield at the end of the season about a pound of wax; and an old hive about twice as much. The finest wax is that which is made in dry, heathy, or hilly countries; but in parts abounding with vineyards it is decidedly inferior.

Although the commonly received notion, which ascribes this substance to the elaboration of the pollen of flowers, which the bees visibly collect on their thighs, had received the sanction of observers not less distinguished than Bonnet and Reaumur (see Pain's D'Alembert), yet the Lusitanian Society, as long ago as the year 1768, was not unconvinced of the fact, that the wax, instead of being discharged from the mouth, is secreted in the form of thin flakes among the abdominal rings or segments. In 1792, the celebrated Mr. John Hunter detected the genuine reservoir of the wax under the belly of the bees, and gave an account of his observations in the Philosophical Transactions, (vol. lxxxii. part 1.) On elevating the lower segments, he observed plates of a fusible substance, which he ascertained to be wax; and he was convinced, that an essential difference subsists between the pollen, which these little creatures collect with so much care and industry in the form of pellets on their thighs, and the matter of which the combs are constructed. This curious subject has been further investigated by Meffirs. Huber, father and son; and they have demonstrated the organs in which the wax is secreted, though they had eluded the perplexity of Swammerdam, Hunter, and other acute anatomists. These facets, or small compartments, now minutely explained and illustrated by engravings, are peculiar to the working bees, which alone produce wax; and each individual is furnished with eight of them. The wax matter, as it occurs in a fluid state in the secretory organs, differs from the fresh wax of the combs only in being a lea compounded nature, which has been ascertained by trials with spirit of turpentine and sulphuric ether. Proceeding these reflections, our ingenious authors concluded that the common opinion was probably erroneous; because, like Hunter, they had observed swarms, newly placed in the empty hives, construct their combs without fetching home any pollen; while the bees of old hives, where no fresh cells were required, nevertheless provided an ample stock of this powder. In order, however, to determine the point more directly, they confined a recent swarm within an empty straw-hive, leaving at their disposal only a sufficiency of honey and water for their consumption, and preventing them from going beyond the precincts of a well-closeted room; when, in the short space of five days, they had constructed five cakes of a beautiful white though very fragile wax. This experiment was repeated, and was uniformly accompanied by similar results; and therefore they no longer hesi-

tated in admitting the fact, that honey, through the organic intervention of bees, may be converted into wax. In order to determine whether vegetable pollen, also, was susceptible of this conversion, the honey was wholly removed, and the confined bees were fed on fruits and pollen, of which last a large store was left at their disposal; but, though they continued in this situation during eight days, they neither made any wax, nor exhibited any plates under their abdominal rings. Having suspected that the secretion of wax originated in the cohesive principle contained in honey, our authors recur to various experiments, which confidently proved that sugar alone was an excellent substitute for honey, and, on some occasions, afforded a superior wax. They afterwards found, that bees, when left at perfect liberty to roam abroad, act precisely on the same principle in the construction of their combs; and they also discovered, that labourers of two descriptions exist in each hive. The first, susceptible of acquiring considerable dimensions, when they have received all the honey which their stomachs can contain, are principally destined to the elaboration of the wax; while the second, whose abdomen undergoes no sensible change of bulk, neither gather nor retain more honey than is necessary for immediate subsistence, and readily share that which they collect with their companions; who take no charge of flooring the hive with provisions, their appropriate office being to attend the young. These they call nursing or small bees, in contradistinction to those with dilated bellies, and which, as they say, are entitled to the appellation of "wax-workers." The existence and separate offices of these two sorts of bees were sufficiently ascertained. When the hives are filled with combs, the wax-working bees disgorge their honey into the usual magazines, and produce no more wax; but, if they have no receptacle in which they can deposit it, and if the queen finds no cells formed ready for the reception of her ova, they retain in their stomachs the honey which they had amassed; and, at the end of 24 hours, the wax oozes out between the rings, when the fabrication of the combs commences. The nursing bees also produce wax, but in a much smaller quantity than the others.

As for the use of the pollen, our authors have ascertained, that it is collected for the purpose of feeding the young; and they have also found, that bees, fed too long on the syrup of sugar alone, are incapable of rearing their offspring, and at length defeat the hive. The waxy matter, when newly secreted and moulded in its appropriate organs, differs from real wax in being transparent like flakes of tale, white, and quite friable, or brittle; whereas that of which the cells are composed is of a yellowish-white, opaque, and flexible. Our limits will not allow our describing the processes observed by our authors with the aid of a glass apparatus, by which these insects commence and conduct the construction of their combs. The difference of aspect and consistency between cells just formed, and those which are of older standing, cannot fail to attract the attention of every observant aparian. The former are, in fact, of a dull white colour, semi-transparent, soft, and even, without being smooth; but, in the course of a few days, the whole of their internal surface assumes a yellow tint of greater or less intensity; their sharp edges become thicker and less regular; and those tubes, which at first could not refract the slightest pressure, become flexible, somewhat more heavy, and more difficult of solution in hot water. The contour of the orifice of mature cells is bound with a rim of a reddish and odorous resin, which is also employed to cement the angles of other parts of the cell. This folder or varnish is found, on chemical trial, to be identical with the propolis, and
and quite distinft from the wax. Meffrs. Huber have not
only established this important fact, but detected the origin
of the propolis itself. Having obtained branches of the
wild poplar, cut in spring before the development of their
leaves, with very large buds filled with vifcous, reddih, and
odorous juice, they placed thev in the way of the bees to
the fields, fo that they must fee them soon after this ar-
angement, a bee alighted on one of the branches, and ap-
ached one of the largest buds; she then separated its
flids with thev teeth, attacked the parts which she had half-
opened, pulled off filaments of the viscid matter with which
they were filled, and then seized, with one of the legs of
the second pair, the substance held between her jaws,
brought forwards one of her hind-legs, and finally placed in
the basket of that leg the little ball of propolis which she
had just collected. Having accomplished this object, she
again opened the bud in another place, carried off new
flreads of the fame matter with her teeth, laid hold of them
with the legs of the second pair, and placed them nicely on
the other basket. She then took her departure, and re-
joined her hive. In a few minutes afterwards, a second bee
alighted on the fame branch, and loaded herself with pro-
polis in the fame manner. This propolis was found to be
different from the matter which imparts the yellow colour
to the wax, which is probably secreted in the cavity of the
teeth, and deposited on the wax. We observe, however,
that bees are not contented with merely painting and var-
inifhing their cells, but they also impart additional solidity
to their aggregate mount by the use of a mortar, com-
pofed of wax and propolis; and which the ancients, who had
not overlooked this department of their economy, termed
mellis, or pfllicerum. (See Paoporis.) With the neces-
sary documents before us, we cannot forbear intro-
ducing some further observations on the economy of these
insects, though they are not immediately connected with the
subject of this article. As the clofeneds of a hive, and the
multitude of living creatures which inhabit it, (amounting
sometimes to twenty-five or thirty thoufand,) are circum-
stances which feem to preclude a free ventilation and re-
newal of air, we might be induced to fuppofe that bees are not
endowed with any particular fyslem of respiratory organs,
and that they are capable of excifing in any atmosphere, how-
ever vitiated. As a teft of this supposition, our ingenious
and perfevering authors recur to various experiments;
which incontestibly prove, that these insects cannot long
exist either in vacuo, or in air that is contaminated by noxious
gases; that, in short, they breathe like other animals of their
cafs; and that they are fpeedily deprived of life if the pro-
cefs of repiration be arrefled. Yet it results, from audio-
metrical trials, that the air of a well-flocked hive is equally
pure with that of the atmosphere. It has been ascertained,
too, that neither wax nor pollen favours the production of
oxygen gas, and that the bees themselves have no internal
faculty of generating vital air; fince, if that of the atmo-
sphere be entirely excluded, they are obliged to perifh in the
courfe of a few hours. Our authors, therefore, took an
opportunity of examining, whether the industry of these
insects prefented no particular caufe of this phenomenon;
and at length they were ftruck by the connection which might
fubfift between the circulation of the air and that beating of
the wings which they had recently obferved, and which occa-
sioned a continual humming in the interior of their habi-
tation. They fuppofed that the play of their membranes,
which imprefs the air with fufficient force to elicit from it a
very diftinct sound, might be diftined to replace that which
had been vitiated by repiration. Although this may feem
to be a trivial caufe for counteracting the pernicious effedt
above fitated, yet by putting the hand near to a fanning-
bee, we fhall perceive that the agitates the air in a manner
that is very fenfible, and moves her wings with fuch rapidity
as that they are fiercely diftinguifhable.

United at their edge by means of small hooks, the two
wings of each fide prefent a larger surface to the air, on
which they have to flrike; they form, besides, a flight con-
vey, which fhould fomewhat contribute to increase their
energy; and we may be fatisfied that they describe an arc
of 90°, because we fee them, fimultaneously, on the two ex-
tremes of their vibrations. When engaged in this exer-
cise, the bees cling fati to the fand with their legs, the first
pair being projected forwards, the second feparated and
fixed to the right and left of the body, while the third,
clofely approximated, and in a direétion perpendicular to
the abdomen, contributes to support the hinder parts in an
elevated poifion. During the fine feafon, we may alwats
obferve a certain number of bees agitating their wings in
front of the entrance to their hive; but we may alfo be con-
vinced, by obfervation, that flll more of them are employed
in fanning within their dwelling. The ordinary flation of
the ventilating bees is on the lower floor of the hive. All
those which are occupied in this way, on the outside, have
their heads turned towards the entrance, but thofe within
prefent their backs to it. These bees seem to arrange them-
selves methodically, fo that they may manage the ventilating
process with the greateft efteem; being divided into fles,
which terminate at the entrance of the hive, and are some-
times difposed like fo many diverging rays; but this order
is not uniform; and it is probably owing to the necessity
to which the fanning bees are subjected of leaving room for
fuch as go and come, whose rapid courfe confrains them to
form in file, that they may avoid being jolted and over-
turned at every inftant. More than 20 bees may fometimes
be seen ventilating in the lower part of the hive; but their
number at other times is smaller; and each of them vibrates
her wings for a longer or fhorter period. They have been
obferved to continue the exertion during 25 minutes,
without refting; although they fcam occasionally to take
breath by infufliding the vibration of their wings for an al-
mofk imperceptible inftant; but, as foon as they ceafe from
fanning, others take their place, fo that the humming noife
in a well-filled hive never fuffers interruption.

But to return from this digreflion to the principal subjeft
of the article.

Wax. To procure the wax from the combs for ufe; after leparating the honey from them as much as po-
sible by the prefs, they are either foaked for fome days in
clear water, in order to extract all the honey, or they are
broken into pieces, and spread on a sheet near the hives, fo
that the bees in time fack out all the honey that is left, and
reduce the wax into small fragments like bran. Then the
whole of the wax is put into a large kettle, with a fufficient
quantity of water; and with a moderate fire, it is melted,
and then strained through a linen cloth, by a prefs, and thus
freed from all remaining impurity. Before it is cold, they
feem it with a tile, or a piece of wet wood, and call it,
Wax. Yellow. To procure the wax from the combs for ufe; after leparating the honey from them as much as po-
sible by the prefs, they are either foaked for fome days in
clear water, in order to extract all the honey, or they are
broken into pieces, and spread on a sheet near the hives, fo
that the bees in time fack out all the honey that is left, and
reduce the wax into small fragments like bran. Then the
whole of the wax is put into a large kettle, with a fufficient
quantity of water; and with a moderate fire, it is melted,
and then strained through a linen cloth, by a prefs, and thus
freed from all remaining impurity. Before it is cold, they

WAX.

while yet warm, in wooden, earthen, or metalline moulds; having first anointed them with honey, oil, or water, to prevent the wax from sticking. Some, to purify it, make use of Roman vitriol, or copperas; but the true secret is to melt, scum it, &c. properly, without any ingredients at all.

The best is that of a high colour, an agreeable smell, somewhat resembling that of honey, soft, somewhat unctuous to the touch, but not sticking to the fingers, nor to the teeth when chewed. When new, it is of a lively yellow colour; it is somewhat tough, yet easy to break; by age, it loses its fine colour, and becomes harder and more brittle. In winter it becomes considerably hard and tough. It is deprived of its yellow colour and smell by exposing it in thin lamina to the action of the light and air, in the process of bleaching; by which it becomes perfectly white, scented, somewhat harder, and less greasy to the touch. However, wax is often fophosticated with resin, or pitch, coloured rocoo, or turmeric.

The presence of resin may be suspected when the fracture appears smooth and shining, instead of being granulated: and it may be fatuated by putting small pieces of the wax into cold alcohol, which will readily dissolve the resinous part, without affecting the wax in any considerable degree.

Its adulsion with earth or peas meal may be suspected when the cake is very brittle, and the colour inclining more to grey than bright pale yellow; and they may be separated by immelting and straining the wax. White wax is sometimes adulterated with white oxyz of lead, in order to increase its weight. This may be known by melting the wax in water, when the oxyd falls to the bottom of the vessel.

It is also adulterated by tallow, fuel, or any kind of animal fat. It then becomes more fusible, and when rebleached and exposed to a hot sun, it is very apt to cake. It likewise loses its semi-transparency, the distinguishing property of pure bleached wax. This adulteration may be detected by boiling alcohol, which will dissolve wax, but not tallow.

Wax, White. The whitening, blanching, or bleaching of wax, is performed by reducing the yellow part, first, into little bits or grains, and melting it in a copper cauldron, with water just sufficient to prevent the wax from burning. The cauldron in which the wax is melted is so disposed, that it may flow gradually through a pipe at the bottom into a large tub filled with water, and covered with a thick cloth, to preserve the heat till the water and impurities are settled. From this tub the clear melted wax flows into a vessel, the bottom of which is full of small holes, about the size of a grain of wheat, and hence it falls in small streams upon a cylinder, constantly revolving over water, into which it occasionally dips, so that the wax is cooled, and at the same time drawn out into thin shreds or ribbands. The continual rotation of the cylinder carries off these ribbands as fast as they are formed, and distributes them through the tub. The wax, thus granulated or flattened, is exposed to the air on linen cloths, stretched on large frames, about a foot or two above the ground, in which situation it remains night and day for several days, exposed to the air and sun; and thus the yellow colour nearly disappears. In this half-bleached state, it is heaped up in a fold mas, and allowed to remain for a month or six weeks; after which, to complete the process of whitening it, it is re-melted, and ribbanded, and bleached as before, (in some cases several times) till it wholly loses its colour and smell. Some manufacturers, in remelting it, add alum or cream of tartar, which are supposed to increase the whiteness and solidity of the wax. Some also, instead of spreading the ribbands of wax on cloths, lay evenly a broad course of bricks, which are frequently watered, so that the wax is kept from melting by the sun's heat absorbed by the bricks.

When the sun and air have at length perfectly bleached the wax, some melt it for the last time in a large kettle; out of which they call it, with a ladle, upon a table, covered over with little round dents or cavities, of the form of the cakes of white wax, as fold by the apothecaries, &c. having first wetted those moulds with cold water, that the wax may be the more easily got out. Lastly, they lay out these cakes to the air for two days and two nights, to render it more transparent and dry.

As the volatile sulphureous acid has the property of destroying more quickly almost all the colours of vegetables, it has been suggested by Macquer, the author of the Chemical Dictionary, that this bleaching might perhaps be shortened, by exposing ribbands of yellow wax to the vapour of fullphur, as it is practised for wool and flax; but this process has not been found to succeed.

However, the operation of bleaching wax above described can be performed well only in fine weather, as it depends chiefly on the action of the sun. This circumstance being attended with much inconvenience to the manufacturers, the discovery of a method of whitening wax independently of the feasons would be very useful, and has been recommended to the attention of chemists by some economical societies.

With a view to discover such a method, Mr. Beckman has made experiments, an account of which is published in the fifth volume of the "Novi Commentarii Societatis Regiae Scientiarum Gottingen." According to these experiments, thin pieces of yellow wax were whitened and hardened, by being digested and boiled in diluted and undiluted nitrous acid, in a few hours. But the wax thus whitened, being melted by means of boiling water, was observed to acquire a yellow colour, less intense, however, than it was before it had been treated with the mineral acids. The marine and vitriolic acids were less effectual than the nitric or nitro-muriatic. He exposed wax to the flames of burning sulphur, but without success. Yellow wax being melted in vinegar, was rendered of a grey colour. The oil of tartar whitened wax, but less effectually than acids had done; and this wax being washed in water, and afterwards digested in nitrous acid, was rendered still more white; but upon melting it in water, a yellowish tinge returned. He liquefied wax in solutions of nitre and alum, but without any good effect. Spirit of wine, which is recommended by Mr. Boyle for this purpose, did indeed whiten the wax, but changed it to a butyrous substance, so frothy, that its bulk was increased thirty times. Reflecting that tartar is purified from its oily particles by means of a calcareous earth, he tried the effects of a kind of fuller's earth, which he threw upon wax liquefied in water, and agitated the mixture. This method rendered wax of a greyish colour, and is, therefore, recommended by him as preparatory to bleaching; the time necessary for which, he thinks, may be thus greatly shortened.

M. Senebier made some remarks on the effect of light, and other supposed dicing agents. Some yellow wax was melted, and thinly spread upon a plate of glass; and a similar plate was laid upon it when hot; and the edges of the plates were cloathed with sealing-wax. Thus the bees' wax was deprived of the access of air, and it was placed in the sun, to the light of which it was exposed for four or five hours daily. Another quantity of wax was included between plates in a like manner, but kept in the dark. In two days the wax exposed to the sun began to bleach, and

Vol. XXXVIII.
WAX.

in a month's time the whole, when it did not exceed one-sixth of an inch in thickness, was quite white; whilst no change at all took place in that which was kept in darkness.

Alcohol has no sensible action on wax when cold, but if the fluid be boiled, it will diffuse rather less than one-twentieth of its strength in water; and the greater part of it separates, when cold, in the form of thick, milky flocculi, while the small quantity that remains is wholly precipitated by water. Such is the result of Pearson's and Botloch's experiments; whereas Fourcroy, Chaptal, and Nicholsohn affirm, that it is insoluble in this fluid. Sulphuric ether diffuses wax when heated, and much more copiously, than alcohol diffuses it, but the larger part, like that of the former, is separated by cooling, and the remainder by water. Wax boiled in caustic potash makes the fluid turbid, and in process of time rises to the surface in a flocculent form. The portion of the wax, held in solution by the clear alkaline liquor, may be separated by an acid, and the residue floating on the surface is far converted into a faponaceous state as to have lost its inflammability, and to be no less soluble in pure water than white soap, and again precipitable by acids nearly in its original form, with a restoration of its inflammability. Pure ammonia nearly resembles the fixed alkalis in its action; but the resulting faponaceous form is less soluble in water.

When yellow wax has been long swimming in a solution of carbonate of potash, it becomes grey; and this colour is entirely changed into a milk white by subsequent digestion in nitric acid, and the wax refurnishes its whiteness. If wax be distilled with a heat greater than that of boiling water, it may be decomposed. By this distillation, a small quantity of water is filr separated from the wax, and then some very volatile and penetrating acid, (probably a modification of the acetoxy, accompanied with a small quantity of a very fluid and very odoriferous oil. As the distillation advances, the acid becomes more and more strong, and the oil more and more thick, till its consistence be such, that it becomes solid in the receiver, and is then called butter of wax. When the distillation is finished, nothing remains but a small quantity of coal, which is almost uncontrollable, from the want of some fatine matter. Wax cannot be kindled, unless it be previously heated, and reduced into vapours; in which respect it resembles fat oils. The oil and butter of wax may, by repeated distillations, be attenuated, and rendered more and more fluid, because some portion of acid is thereby separated from these substances; which effect is similar to what happens in the distillation of other oils and oily concretes; but this remarkable effect attends the repeated distillation of oil and butter of wax, that they become more and more soluble in spirit of wine; and that they never acquire greater consistence by the evaporation of their more fluid parts. Boerhaave kept butter of wax in a glass vessel open, or carefully closed, during twenty years, without acquiring a more solid consistence. Wax, its butter, and its oil, differ entirely from essentia! oils and resins, both in the above-mentioned properties; and in all these perfectly resemble sweet oils. Hence Macquer concludes, that wax only resembles resins in being an oil rendered concrete by an acid; but that it differs essentially from these in the kind of oil, in which it is of the nature of essential oils; while in wax and other analogous oily concretes, it is of the nature of sweet, unctuous oils, that are not aromatic, and not volatile, and are not obtained from vegetables by expression.

Although wax is not dissoluble at all in watery liquors, yet the gelatious solution obtained by boiling it in spirit of wine, by mixture with a thick mucilage of gum arabic, becomes soluble in water, so as to form therewith an emulsion or milky liquor: the wax itself is made in like manner soluble, without the intervention of spirit, by thoroughly mixing it with the gum in fine powder; but when thus diffused, it proves still insipid, and perfectly void of acrimony.

Wax is soluble abundantly in the fixed oils, and melted with them, produces an uniform mass, the consistence of which, whatever be the proportion of each, is intermediate between the two. It is dissolved but sparingly in essential oils.

Bleached wax burns with a very pure white light, without any offensive smell, and with much less smoke than tallow; and as it is less soluble than tallow, it requires a smaller wick. (See CANDLES.) Bleached melts at about 156° of Fahrenheit; and the unbleached at 143°, according to Pearson and Nicholsohn, and also Dr. Botloch, but at 147° according to Fourcroy; whilst tallow melts at 92°, spermaceti at 133°, adipocere at 127°, and the pala of the Chinese at 145°. (See Nicholsohn's Journal, vol. i. p. 70, 470.) The specific gravity is less than that of water, being about .96.

The yellow wax is brought to market in round cakes about two inches thick; and large quantities of it are imported from the Baltic, the Levant, and the Barbary coast.

The white wax is used in the manufacture of candles, torches, tapers, figures, and a variety of other wax-works. See CANDLES, &c.

It is also an article of the Materia Medica, and used as an ingredient, partly for giving the requisite consistence to other ingredients, and partly on account of its own emollient quality, in plasters, cerates, and divers pomatum and unguents for the complexion.

The yellow sort, dissolved into an emulsion, or mixed with spermaceti, oil of almonds, confere of roes, &c., into the form of an electuary; or divided, by draining into it, when melted over a gentle fire, as much as it will take upon powderiness, as the compound crab's-claw powder, has been given also internally, and, as some have pretended, often with great success, in diarrheas and dysenteries, for obtunding the acrimony of the humours, supplying the natural mucus of the intestines, and healing their excoriations or erosions.

The empyreumatic oil, into which wax is resolved by distillation with a strong heat, is greatly recommended by Boerhaave and others, for healing chaps and roughness of the skin, for distressing chilblains, and with proper fomentations and exercise, against fistulfs of the joints, and contractions of the tendons. It is, without doubt, says Dr. Lewis, highly emollient; but does not appear to have any other quality by which it can act in external applications; it has nothing of the acrimony or pungency which prevail in all the other known diffusible vegetable oils; though in smell it is not a little disagreeable and empyreumatic; a circumstance which occurs it to be at present more rarely used than formerly. As the wax swells up greatly in the distillation, it is convenient to divide it, by melting it with twice its weight of sand; or putting the sand above it in the retort, that it may mingle with the wax when brought into fusion. The oil, which is preceded by a small quantity of acid liquor, coagulates in the neck of the retort, from whence it may be melted down, by applying a live coal, and made fluid by redistilling it two or three times without addition. The feces remaining, after expressing the wax, have been used
WAX.

The official preparations are as follow: *cera flava purificata* of Dub. Ph.; *oxidum antonii vitrificatum* of Edinb.; *emplastrum cere* of Lond. and Dub.; *emplastrum commune* of Lond.; *plastis composition* of Lond.; *empl. oxiis ferri rubri* of Edinb.; *empl. affaefidae* of Edinb.; *empl. gummofum* of Edinb.; *empl. melodes* of Edinb. and Lond.; *empl. galbani* of Dub.; *empl. aromaticum of Dub.; *ceratum of Lond.* and Dub.; *ceratum calamine* of Lond. and Dub.; *ceratum refina* of Lond. Edinb. and Dub.; *ceratum fabinae* of Lond. and Dub.; *ceratum faponis* of Lond.; *unguentum picis aridae* of Lond. and Edinb.; *ung. infus melodes* of Edinb.; and *ung. cambaroids* of Dub. Ph. For the first, see white-wax below. The second, or vitrified oxyz of antimony with wax, formerly waxed glafs of antimony, is formed by melting one part of yellow wax in an iron vessel, and throwing into it eight parts of oxyz of antimony vitrified with sulphur, reduced to powder, and roasting the mixture with a gentle fire for a quarter of an hour, flirring it affidually with a spatula; then pouring out the latter, and when cold rubbing it into a powder. This preparation is diaphoretic and cathartic, occasionally exciting nausea and vomiting. It was formerly thought to possess efficacy in diarrhoea and dyfentery; but is now scarcely ever preferred. The dose may be from gr. jij. to gr. xv. given twice or three times a day. For the *empl. cere*, see Wax *Plaster.* For the 4th, see *Emplastrum et Cynino.* For the 5th, see *Compound Pitch Plaster.* For the 6th, see *Plaster of red Oxyz of Iron.* For the 7th, see *Affa Fetida Plaster.* For the 8th, see *Gum Plaster.* For the 9th, 10th, and 11th, see *Plaster.* For the others, compre- hending *cerates and ointments.* See UNGUENTUM.

The bleached or white wax is generally melted and caff, in the manner already flated, into thin dice, about 5 inches in diameter, in which form it is found in the flops. For medical purposes, it is regarded as a demulcent; and has been sometimes administered in obinate caffes of diarrhoea and dyfentery, with the view of softening the bowels; which effect is better produced by simple mucilages and solutions. It is generally exhibited diffused in mucilaginous fluids by means of foap, in the proportion of 1/3 part of the wax, with which it is first melted, and then rubbed in a mortar, with the fluid gradually added; but a preferable method is to be that of Poeriner, which is first to melt the wax with olive oil, and then mix the oil compound while hot with the mucilaginous fluid, by triturating with the yolk of an egg. The dose is a copulful of the emulsion, containing about 1/2j of wax, given every four or five hours. This wax, as well as the yellow sort, is much ufed in the composition of plasters and ointments. The official preparations are *ceratum cetacei* of Lond. Edinb. and Dub. pharmacopoeias; *unguinetum cetacei* of Lond. and Dub.; *ung. hydragyni nitric-oxydi* of Lond.; *linimentum simplices* of Edinb.; and *ung. simplices* of Edinb. See *Ceratum, Liniment, and Unguent.* Lewis's Mat. Med.

Yellow wax is made soft with turpentine, yet retains its natural colour. Red wax is only the white melted with tur- pentine, and reddened with vermillion or alkanet. Verdi- grize makes it green; and burnt paper, or lamp-black, black. Some travellers tell us of a natural black wax; affuring us there are bees, both in the Ealt and Weft Indies, that make an excellent honey, included in black cells. Of this wax, they say, it is, that the Indians make those little vases, in which they gather their balsam of Tolu.

Wax is also produced by the secretion of many plants, and forms the filvery powder or bloom, which covers their leaves and fruit. It is found very abundantly combined with refined, covering the trunk of the wax-palm (*Garcyphereus*), of South America, found in the Quinolou mountains, 180 feet high, with leaves 20 feet long, the trunk of which is covered with the waxy secretion about two inches thick, and confiding of two-thirds of resin and one of wax; and very pure, encroaching the seeds of the *Myrica cerifera,* or wax-tree of Louisiana, and other parts of North America. The *Pelis* of the Chinese is an animal wax, and the white lac of India appears to be a variety of wax; so that wax may be regarded, in the extended meaning of the term, both as an animal and a vegetable product. The croton feb- ferum, the tomex febfera, the poplar, the alder, the pine, as well as the *Myrica*, afford a concrete inflammable matter by decotion, that more or lefs resembles tallow or wax, that is, a fixed oil satured with oxygen. But the *Myrica* cerifer supplies it in the greatest abundance. The grains of this tree, and the shining wax obtained by boiling them in water, have been long ago, *viz.* in 1722 and 1725, noticed in the Hiftory of the Academy of Sciences. The wax, it was observed, is drier and more friable than our's; and it was found, that the liquor in which the grain had been boiled, and from which the wax was procured, afforded, on evaporation, a kind of extract that checked the most oblitinate dyfenteries; and the inhabitants of Louifiana are said to have made candles of the wax. Several authors have mentioned different species of these trees; but the wax they afford has more lately been the subject of experimental investigation, particularly by M. Cadet and Dr. Bollock. The most fertile of these shrubs affords near seven pounds of berries, the gathering of which employ several families. These berries are thrown into a kettle, and covered with water. Whifl the water is boiling, the grains are stirred about against the fides of the vessel, so that the wax may more easily come off. In a little time it floats on the water like fat, and being collected, is strained through a coarse cloth, to free it from any impurities. This operation is repeated with fresh berries; and when a confiderable quantity of wax has been obtained, it is laid upon a cloth to drain off the water; and it is then dried and melted a second time; and when thus purified, formed into maffes. Four pounds of berries afford about one of wax: which which is first obtained is generally yellow; but in the latter boilings it assumes a green colour, from the pellicle with which the kernel of the berry is covered. M. Cadet made a variety of experiments on these berries, and found that the powder which was obtained from them afforded an astringent solu- tion by alcohol, and that it contained gallic acid, but no tannin; and to this acid it attributes their effect in dyfenteries. The wax, obtained either by the decoction of the grains, or the solution of the powder when precipitated from alcohol by water, when melted, is always of a greenish-yellow; of a firmer confidence than bees' wax, dry, and sufficiently friable to be pulverized; and evidently more oxygenated than the wax prepared by bees. Candles made of this wax yielded a white flame, a good light, without smoke, and without guttering; and when quite fresh, they emit a balfamic odour, confidered in Louifiana as very fa- burious to perfons in bad health. Distilled in a retort, this wax, for the most part, passes over in the form of butter. This portion is much whiter, and has no more confidence than tallow. Another portion that was decomposed afforded a little water, with some empyreumatic oil and febacic acid. Much carbonated hydrogen gas and carbonic acid gas were difcharged; and there remained in the retort a black and coaly bitumen. Ether was found to difsolve this
WAX.

this wax better than alcohol. Oxygenated muriatic acid rendered this, as well as bees'-wax, perfectly white; but the vegetable wax was bleached with the greatest difficulty. The solution in ammonia is of a brown colour, and a portion of the wax is rendered foamy; and it forms soap with fixed alkali. When the soap of Myrica is decomposed, a very white wax is obtained, but in a state unfit for our uses. Litharge dissolves very well in this melted wax, and forms a hard plaster, the consistence of which may be diminished at pleasure by the addition of a little oil. For bleaching this wax, M. Cadet observes, that two re-agents present themselves to manufacturers, the sulphuric acid and the oxygenated muriatic acid. He proposes the following method as the most speedy in its effect:—Let the wax be reduced to a very divided state, and stratified in a cask with superoxygenated muriate of lime, and let them remain for some time in contact without water. Let the salt be afterwards decomposed with water, acidulated by the sulphuric acid; taking care to pour the water a little at a time at different intervals, until there shall be no longer any perceptible diffusion of muriatic gas; at which period a large quantity of water is to be added, and the mixture agitated with a staff. The insoluble sulphate of lime falls down by repose, while the bleached wax rises and swells at the surface. This is to be washed and melted on the water bath. Our author closes his memoir with recommending the culture of the plant that yields this wax, and with a brief detail of methods for effecting this purpose. Dr. Bottock has also professed an inquiry into the nature and uses of myrtle wax. He finds that in its more important properties it resembles bees'-wax, but that in some respects they differ from one another. The myrtle wax is moderately hard and convenient, possessing in part the tenacity of bees'-wax, without its brittleness, and also, in some degree, the brittleness of resin. The prevalent colour is pale green, tending in moss of the pieces to a dirty grey; in others it is lighter, more transparent, and of a yellowish tinge. Its specific gravity is about 1.0150, water being 1.0000, so that it sinks in it, and the white bees'-wax being .9600. Water has no action upon it, either when cold or at the boiling heat. Alcohol, when cold, does not affect it; but 100 parts, by weight, of this fluid, when boiling, dissolve about five parts of the wax. Nearly four-fifths are deposited by the cooling of the alcohol; one-fifth remains suspended, but in the course of a few days is slowly deposited, or may be precipitated by the addition of water. Sulphuric ether, when at the common temperature of the atmosphere, dissolves only a small quantity of this wax, but acts upon it rapidly when boiling. It takes up somewhat more than one-fourth of its own weight. As the ether cools, it is mostly separated, and the small residue may be precipitated by water. After solution, the wax is nearly colourless, and the fluid assumes a beautiful green hue. The deposit by evaporation somewhat resembles spermaceti. Rectified oil of turpentine, at the temperature of the atmosphere, softens the wax, but does not dissolve it: aided by a moderate heat, 100 grains of the turpentine dissolves six grains of the wax. The turpentine acquires a light green tinge, part of the wax is separated as the fluid cools, and part remains permanently dissolved in it. Pure potash renders it colourless by boiling, and forms a soap with a small part, which being decomposed by acid, affords the wax nearly unchanged. Pure ammoniaca acts nearly as potash, but more feebly. The three principal mineral acids act upon the myrtle wax, but with no great force. The sulphuric acid, with a moderate heat, dissolves about one-twelfth of its weight, and converts it into a thick, dark-brown mafs, which on cooling becomes nearly con-·crete, but without any separation of the wax. The nitric and muriatic acids, even when heated, seem to posses little attraction for the wax. From such experiments, Dr. Bottock assigns to myrtle wax, with a considerable degree of probability, the place which it should occupy among chemical substances. Its inflammability, fusibility, infusibility in water, and the action which takes place between it and the alkalies, indicates its affinity to the fixed oils; while its texture and consistence, and more particularly its habits with alcohol and ether, manifest a resemblance to the resins. Upon the whole, we may consider the myrtle wax as a fixed vegetable oil, rendered concrete by the addition of a quantity of oxygen; and seeming to hold the fame relation to the fixed, which resins do to the essential oils of vegetables. Dr. Bottock has instituted a comparison between myrtle wax and other substances which it resembles, such as bees'-wax, spermaceti, adipocere, and the crysalline matter of biliary calculi; and, upon the whole, deduces this conclusion, that though these five substances posses certain properties in common, and have a degree of similarity in their external appearance, yet, that they differ materially in their chemical nature. There is indeed, he says, reason to conjecture, that they are all composed of the same elements, combined together in different proportions, and with different degrees of attraction. Nichollos's Journal, vol. iv. 8vo.

WAX, Chafe. See CHAFE.

WAX, Crude or Rough, called by the French cire brute, in Natural History, a name given to a substance called by the ancients erithace, fandarac, and ambrosia.

We seem to have no name for it in English, but may call it after the name of the French, Rouh wax.

The Dutch call it the food of the bees, and, that, perhaps, very properly, there appearing many reasons to think that the bees eat it.

This is the yellow sublimate found on the hinder legs of bees in small lumps, of which, as Reaumur and some others erroneously thought, wax is made by this insect. See Payne d'Abelès.

WAX, Myrtle. See MYRICA, and WAX, Supra.

WAX, Virgin, Propolis, is a sort of reddish wax, used by the bees to flop up thecells or holes of the hive. It is applied just as taken out of the hive, without any art, or preparation of boiling, &c. It is the most tenacious of any, and is held good for the nerves. See PROPOLIS.

WAX, Sealing, or Spanish Wax, is a composition of gum lacca, melted and prepared with resins, and coloured with some suitable pigment.

There are two kinds of sealing-wax in use: the one hard, intended for sealing letters, and other such purposes, where only a thin body can be allowed; the other soft, designed for receiving the impressions of seals of office to charters, patents, and such written instruments.

The best hard red sealing-wax is made by mixing two parts of shell-lac, well powdered, and resin and vermilion, powdered, of each one part, and melting this combined powder over a gentle fire; and when the ingredients seem thoroughly incorporated, working the wax into flocks. Seed-lac may be substituted for the shell-lac; and instead of resin, boiled Venice turpentine may be used. A coarser, hard, red sealing-wax may be made, by mixing two parts of resin, and of shell-lac, vermilion and red-lead, mixed in the proportion of one part of the vermilion to two of the red-lead, of each one part; and proceeding, as in the former preparation. For a cheaper kind, the vermilion may be omitted, and the shell-lac also, for very coarse ues. The hard black sealing-wax may be prepared in the same manner;
WAX

Using for the best fort, instead of the vermilion, the best ivory black; and for the coarsest fort, instead of the vermilion and red-lead, the common ivory black. For hard green sealing-wax, instead of vermilion, use powdered verdigrise; and for a bright colour, distilled, or crystalls of verdigrise. For hard blue sealing-wax, instead of the vermilion, substitute well powdered smalt, or for a light blue, verditer; or a mixture of both. For yellow hard sealing-wax, substitute mastic or, for a bright colour, turbit mineral, instead of the vermilion. The hard purple wax is made like the red; changing half the quantity of the vermilion for an equal, or greater proportion of smalt, as the purple is defir'd to be more blue or more red.

For uncoloured soft sealing-wax, take of beer-wax, one pound; of turpentine, three ounces; and of olive oil, one ounce; place them in a proper vessel over the fire, and let them boil for some time; and the wax will be then fit to be formed into rolls or cakes for use. For red, black, green, blue, yellow, and purple soft sealing-wax, add to the preceding composition, while boiling, an ounce or more of any ingredients directed above for colouring the hard sealing-wax, and stir the masts, till the colouring ingredient be incorporated with the wax.

The hard sealing-wax is formed into sticks, by rolling the masts on a copper-plate, or stone, with a rolling-board, lined with copper, or block-in, into rolls of any required size. In order to give them the fire-polish, or gloss, a furnace or stove, like a pig, with bars at the bottom for supporting the charcoal, and notches at the top of the sides for putting the sticks of wax over the fire, is usually provided. By means of this stove the sticks of wax may be conveniently exposed to the fire, and turned about, till the wax is so melted on the surface as to become smooth and shining. Hard sealing-wax may be formed into balls, by putting a proper quantity on the plate or stone, and having fashioned it into a round form, rolling it with the board till it be smooth.

The soft wax is easily formed into rolls or cakes, by pouring the melted masts of the ingredients, as soon as they are duly prepared, into cold water, and working it with the hands into any desired figure. Some perfume both thek kinds of wax, by using, for a pound of the wax, half an ounce of benjamin, one scruple of oil of Rhodium, ten grains of mastic, and half of gum tragacanth, each five grains; rubbing the oil with the other ingredients powdered; and when the wax is ready to be wrought into sticks, sprinkling in and well stirring the mixture; or by using one ounce of benjamin, one scruple and a half of oil of Rhodium, and five grains of ambergris, in the same manner. Lewis's Com. of Arts, p. 370. Handmaid to the Arts, vol. ii. p. 34. &c.

WAX-Candles. See Candle.

WAX, To imitate Fruit, &c. in. Take the fruit, and bury it half-way in clay, oil its edges, and the extent half of the fruit; then nimblly throw on it tempered alabaster, or plaster of Paris, to a considerable thickness. When this is concreted, it makes the half mould, the second half of which may be obtained in the same way. The two parts of the mould being joined together, a little coloured wax, melted, and brought to the due heat, being poured through a hole made in any convenient part of the mould, and presently shok every way therein, will represent the original fruit. Boyle's Works abridg'd, vol. i. p. 136.

Here we must not forget that very invention of M. Benoist, a man famous at Paris for his figures of wax. Being by profession a painter, he found the secret of forming moulds on the faces of living persons, even the fairest and most delicate, without any danger either to their health or complexion: in which moulds he cast marks of wax; to which, by his colours, and glafs eyes imitated from nature, he gave a fort of life: insomuch as, when clothed in proper habits, they bore such a resemblance, that it was difficult distinguishing between the copy and the original.

WAX, Gilding. See GILDING.

WAX, Grafting, is a composition serving to bind or fix the bud, or graft, in the cleft of the stock.

Instead of grafting wax, the country gardeners, &c. only use clay, over which they lay a piece of linen cloth, and to keep it moist; and to prevent its cracking with the heat of the sun, they tie moss over it. But the wax ordinarily used is a compott of one pound and a half of pitch, a quarter of a pound of wax, and an ounce of oil of almonds, melted and mixed together; with the addition, in spring or autumn, of a moderate quantity of turpentine.

For cleft-grafting, whip-grafting, and grafting by approach, Mr. Mortimer recommends tempered clay, or soft wax; but for ring-grafting, clay and horse-dung.

WAX, Green. See GREEN WAX.

WAX, thorough, in Botany. See BUPLEURUM.

WAX, Painting in. See ENCAUSTIC PAINTING.

WAX-Bill. See Loxia Atricapillus.

WAX-Scot, or Wax-fish, Cerogium, in our Ancient Customs, money paid twice a year towards the charge of maintaining lights, or candles, in the church.

WAXENBURG, in Geography, a town of Anflria; 10 miles W. of Freylaid.

WAXHOLM, a fortres on the coast of Sweden, in the Baltic; situated on a small island at the entrance of the channel of the Malar Lake, and built in the year 1649. It has since been greatly improved and enlarged, so that it has the appearance of a little town. Here all homeward-bound ships are searched. On this island, which is called Waxen, besides this fort, are a church, a school, and a custom-house.

The chief occupation of the inhabitants is fishing; 16 miles E. of Stockholm. N. lat. 59° 21'. E. long. 18° 16'.

WAXING, CERATION, in Chemistry, the preparation of any matter to render it fit and disposed to liquefy, or melt, which of itself it was not.

This is frequently done, to enable things to penetrate into metals, or other solid bodies.

WAXING, in the Manufacture of Calico, &c., a process by which the operation of certain colours is refilled by stoppiong out with wax; but it is too expensive to be often adopted among calico-printers, who are anxious to finish their prints with the least possible charge. Formerly this mode was very generally practiced, and great quantities of wax were consumed in the process. In the East Indies wax is still used for preserving the whites in calico-printing. In printing the filk handkerchiefs called bandanas, a process called waxing is still followed. It consists in making a preparation of tallow and rosin very liquid by heat, and in printing it in that state with a block upon the filk. When such goods are piled through the blue vat, those parts which are covered with the tallow and rosin are preferred from the action of the indigo, and remain white, while the whole remainder is dyed a fast blue. The method afterwards taken to discharge a part of this blue, and produce yellow, orange, &c. is as follows.—The agent employed for this purpose is the nitrous and sometimes the nitro-muriatic acid. This was used for the purpose of putting yellow figures upon blue filk handkerchiefs. With this view aqua fortis, nitro-muriatic acid, of a strength suitable to the kind of blue that is to be discharged, is mixed either with gum tragacanth, or with flour paste, to a proper consistence, and in this form it is printed on the filk, by means of a common block, on which
the intended pattern is cut. The consequence of this is, that wherever the acid attaches, there the original colour is discharged, and a yellow dye is produced in its place. The pieces are then scamed, by palling them over a vessel containing boiling water, which gives brilliancy to the colour, and finishes the operation. Parkes's Ed. vol. ii. p. 149. 170. See Dyeing Work, and Discharging of Colour.

WAY, in Geography, an island in the East Indian sea, near the E. coast of the island of Celebes, about thirty miles in circumference. S. lat. 3° 33' E. long. 123° 15'. See Pulau Way.

WAY, Via. See HIGHWAY, ROAD, TURNPIKE, and VIA.

Roman ways are divided into consular, praetorian, military, and public. See VIA.

We have four notable ones of these in England; anciently called chinnim quatuor, and intitled to the privileges of paax regis. The first is Way-lying-street, or Waybeling-street, leading from Dover to London, Dunitable, Towceiter, Atherston, and the Severn, near the Wrekin in Shropshire, extending as far as Anglesea in Wales. The second, called Hekinold, or Inkbold-street, reaches from Southampton, over the river Ifs at Newbridge, thence by Camden and Litchfield, then passes the Derwent near Derby, to Bollower-cathe, and ends at Timmouth. The third, called Fofa-way, because in some places it was never perfected, but lies as a large ditch, leads from Cornwall through Devonshire, by Tctbury near Stow in the Wolds; and beside Coventry to Leiceftr, Newark, and to Lincoln. The fourth, called Erming, or Ermine-street, stretches from St. David's in West Wales, to Southampton.

WAY. See Weigh.

WAY, Milky. The opinion, long maintained among astro-nomers, but lately controverted, that the milky way contains a great number of stars, has been confirmed by the observations of the ingenious and indefatigable Dr. Herschel. On applying his telescope of the Newtonian form, with an object-speculum of twenty feet focal length and an aperture of 18 inches, to a part of this space, he found that it completely resolved the whole whitish appearance into small stars; which his former telescopes had not light enough to effect. In the tract immediately about the hand and club of Orion, to which his observations were particularly directed, the multitude of stars of all possible sizes that prefented themselves to view was astonishing; and in order to form some just idea of their number, Dr. Herschel counted many fields, and computed from a mean of them, what a given portion of the milky way might contain. Among many trials of this sort, he found that 63 fields, promiscuously taken, contained 110, 00, 70, 90, 70, and 74 stars each. A mean of these gives 79 stars for each field. Hence, by allowing fifteen minutes of a great circle for the diameter of the field of view, it is inferred, that a belt of fifteen degrees in length and two in breadth, which is the quantity often observed by this excellent astronomer to pass through the field of his telescope in one hour's time, could not well contain less than fifty thousand stars, that were large enough to be distinctly numbered. But, besides these, Dr. Herschel supposed at least twice as many more, which, for want of light, he could only see now and then by faint glittering and interrupted glimpses. See Galaxy and Nebula.

WAY of a Ship is sometimes used for the same with the rake. But the term is more commonly understood of the course or progress which the makes on the water under sail. Thus, when the begins her motion, she is said to be under way; when that motion increases, she is said to have fresh way through the water; when she goes apace, they say she has a good way; and they call the account how fast the falls by the log, keeping an account of her way.

And because most ships are apt to fail a little to the leeward of their true course; they are always, in calling up the log-board, allow something for her leeward-way. Hence also a ship is said to have head-way and stern-way.

WAY OF the Rounds, Chemin des Rondes, in Fortification, is a space left for the passage of the rounds, between the rampart, and the wall of a fortified town.

This is not now much in use; because the parapet not being above a foot thick, it is soon overthrown by the enemy's cannon.

WAY, Cowert, Foffs, Gang, Hatch, Spur, and Water. See the several articles.

WAY-Bread, in Agriculture, a name given in some places to the herb plantain, which is very useful in some grazs lands, as increasing the quantity of feed very greatly. See Plantago.

WAY-Going Crop, a term applied to that which is taken from the ground the year the tenant or occupant leaves a farm. Such crops are regulated in many different ways, according to the nature of the leaves. See Lease.

WAY-Leave, a provincial term for the ground purchased or hired to make a waggon-way upon, between coal-pits and the river.

WAY-Pane, in Agriculture, a term applied to the slips left for cartage in watered lands. It is that part of the ground which lies, in a properly watered meadow, on that side of a main where no trenches are formed and taken out, but it floated all the length of the main over its banks, having a drain parallel to it. It serves as a road for conveying the hay upon out of the ground, instead of the teams having to cross all the trenches.

WAY-Thistle, a troublesome plant of the perennial weed kind, with strong roots that branch out in a horizontal manner. Some think it may be weakened or destroyed wholly by frequent cutting over, the beat feanor for which is when it is coming into full bloom; as the wet then gets down its hollow stalk, and aids the rotting of it. In tillage land it is sometimes got quit of by deep repeated ploughing. See Thistle and Weeds.

WAY-Warden, in Rural Economy, a name sometimes given to the surveyor or overlooker of the roads of a district or county.

WAYA, in Geography, a town on the E. coast of the island of Celebes, in Tolo bay. S. lat. 1° 50'. E. long. 121° 52'.

WAYAM, a small island in the Pacific ocean, near the S.E. coast of the island of Waygoo. S. lat. 2° 24'. E. long. 131° 30'.

WAYBAR, a river of Guiana, which runs into the Atlantic. N. lat. 6° 25'. W. long. 58° 6'.

WAYBORN Hope, a creek and point of land, on the N. coast of the county of Norfolk, which takes its name from a village, about five miles from Holt.

WAYED Horse, in Rural Economy, a term applied to an animal of this kind which has been already backed and broken in for work, and which shews a disposition to be tractable and useful. See Horse and Team.

The term is likewise sometimes applied to team-oxen and other animals.

WAYFARING-Tree. See Viburnum.

WAYGAT's Strait, in Geography, a strait of Russia in Europe, separating a small island, called Waygat island, from the continent or country of the Samoides. It is also called Vaigatkskoi and Vaiatach. N. lat. 68°. E. long. 65°. See Vaigatskoi.

WAYGOO, an island in the Pacific Ocean, about 60 miles
Way

Way, a town of America, in the district of Maine, and county of Kennebec, containing 819 inhabitants.—Alfo, a township of Pennslyvania, in Greene county, containing 588 inhabitants.—Alfo, a township of Pennslyvania, in Crawford county, containing 502 inhabitants.—Alfo, a township of Pennsylvania, in Mifflin county, containing 1501 inhabitants.—Alfo, a county of Pennsylvania, containing 4185 inhabitants.—Alfo, a township of Ohio, in the county of Adams, containing 951 inhabitants.—Alfo, a township of Ohio, in the county of Butler, containing 1135 inhabitants.—Alfo, a township of Ohio, in the county of Columbiana, containing 377 inhabitants.—Alfo, a township of Ohio, in Jefferson county, containing 1161 inhabitants.—Alfo, a township of Ohio, in Knox county, containing 478 inhabitants.—Alfo, a township of Ohio, in Montgomery county, containing 431 inhabitants.—Alfo, a township of Ohio, in Pickaway county, containing 742 inhabitants.—Alfo, a township of Ohio, in Scioto county, containing 358 inhabitants.—Alfo, a township of Ohio, in Tuscarawas county, containing 191 inhabitants.—Alfo, a township of Ohio, in Warren county, containing 1862 inhabitants.—Alfo, a county of Kentucky, containing 5323 inhabitants, of whom 226 are slaves; the town Monticello contains 37 persons, including 4 slaves.—Alfo, a county of North Carolina, containing 8687 inhabitants, 2756 being slaves.—Alfo, a county of Georgia, containing 254 inhabitants.—Alfo, a county of the Mississippi territory, containing 1253 inhabitants, 262 being slaves.—Alfo, a large township of New York, in the N. E. part of Steuben county, 15 miles E. of Bath, called Frederick's town till the year 1808: it has a post-office called Roscommon. The S. part is hilly, but the central and other parts are arable and productive. The timber is chiefly oak and walnut, and some pine on the hills. Here are a congregation of Baptists, and a competent number of school-houses. The settlement commenced about 1794, and the population is rapidly increasing. In 1810, the number of people was 1025, and that of senatorial electors 57.

Waynesborough, a town of Georgia, containing 111 inhabitants.

Ways and Means, Committee of. See Supplies.

Wayte, in Geography, a rocky islet in the straits of Macassar, near the west coast of Celebes. S. lat. 0° 40'. E. long. 119° 18'.

Wayto, a town on the S. E. coast of the Isle of Timor. S. lat. 8° 30'. E. long. 126° 9'.

Way-wiser, an instrument for measuring the road, or distance gone; called also perambulator, and podometer, or pedometer.

Mr. Lovell Edgworth communicated to the Society of Arts, &c., an account of a way-wiser of his invention; for which he obtained a silver medal. This machine consists of a navel, formed of two round flat pieces of wood, one inch thick and eight inches in diameter. In each of these pieces there are cut eleven grooves, five-eighths of an inch wide and three-eighths deep; and when the two pieces are fereweled together, they enclose eleven spokes, forming a wheel of spokes, without a rim: the circumference of the wheel is exactly one pole; and the instrument may be coldly taken to pieces, and put up in a small compass. On each of the spokes there is driven a ferril, to prevent them from wearing out; and in the centre of the nave, there is a square hole to receive an axle. Into this hole there is inserted an iron or brass rod, which has the thread of a very fine firework worked upon it from one end to the other; upon this screw hangs a nut which, as the rod turns round with the wheel, advances or recedes towards or from the nave of the wheel. The nut does this because it is prevented from turning round with the axle, by having its centre of gravity placed at some distance below the rod, so as always to hang perpendicularly like a plummet. Two fides of this screw are fixed away flat, and have figures engraved upon them to shew by the progressive motion of the nut, how many circunvolutions the wheel and its axle have made: on one side the divisions of miles, furlongs, and poles, are in a direct, and on the other side the same divisions are placed in a retrograde order.

If the person who uses this machine places it at his right side, holding the axle loosely in his hands, and walks forward, the wheel will revolve, and the nut advance from the extremity of the rod towards the nave of the wheel. When two miles have been measured, the nut will have come close to the wheel. But to continue this measurement, nothing more is necessary than to place the wheel at the left hand of the operator; and the nut will, as he continues his course, recede from the axle-tree, till another space of two miles is measured.

It appears from the construction of this machine, that it operates like circular compasses; and does not, like the common-wheel way-wiser, measure the surface of every stone and mole-hill, &c. but passes over most of the obstacles it meets with, and measures the chords only, instead of the arcs of any curved surfaces upon which it rolls.

Waywoode. See Waywoode.

Weachin, in Botany, the name given by the Indians of America to the maize, or Indian corn, which they cultivated for bread before we knew them.

Weadingsteede, in Geography, a town of the duchy of Holstein; 7 miles E. of Wellingburen.

Weak, or Easy Branch, in the Manage. See Banquet, and Banquet-Line.

Weak-Land, in Agriculture, that which is of a light, thin, open nature, and which is deficient in stipe, or the quantity of proper mouldy material. It is directly contrary to that of the cold watery kind, which often changes the nature and quality of the produce, and retards vegetation in the early spring, or during wet feasions, as it forwards the growth of the crops that are put upon it, but is frequently defective in the amount of produce which is afforded. It is to be improved by the use of proper earthy substances and manures, according as the quality of it may be, and by keeping the surface of it as much covered as possible by suitable green crops, to prevent the too great exposure of it to the action of the sun and winds. Such other means, of the same kind, as the nature, circumstances, and situation of the land will permit, may likewise be pursued. See Soil.

Weak-Pisf. See Pulse.

Weaky, in Agriculture, a term used to signify juicy, in contradistinction to that of dry or husky, as applied to different kinds of food.

Weald, or Weald-Land, a name applied to a kind of wild woody tract of ground of a thick heavy quality in some southern districts, as thofe of Kent, Suffolk, &c.

It is mostly of a deep tenacious clayey, marly, and loamy nature, but occasionally intermixed with earths of a lighter and more open sort. The writer of the account of the agriculture of the former of the above counties, states, that the weald part of that district was in ancient times an immense wood or forest, inhabited only by herds of deer and hogs, and belonged wholly to the king. That by degrees it became peopled, and interpenetrated with villages and towns; and by piece-meal, was, for the most part, cleared of its wood, and converted into tillage and pasture. There are, however,
however, some woodlands still in their original state; and by the author of that of the latter, it is remarked, that if predominant is the timber and wood of one sort or another in the wood of that county, that when viewed from any eminence in the neighbourhood, it presents to the eye hardly any other prospect but a mass of wood, which is, it is thought, to be attributed to the great extent and quantity of wood, preferred by a custom of a nature so extraordinary, that it is not a little surprising no steps have been taken to put an end to it.

When this county was first improved by clearing, as in the other districts, it was, it is said, a common practice to leave a space of wood several yards in width, to encompass each distinct enclosure, as a nursery for the timber and other plants. The sizes of these enclosures being small, they must of necessity contribute to render the general appearance of the tract woody.

Anterior to the Conquest, the wood of this county was, it is said, a continued forest, extending from the borders of the first district to the confines of Hampshire, across the whole of it; and the names of a variety of parishes situated in this line, and evidently derived from Saxon original, attest this fact to the present day. In short, the forest now remaining occupies, it is said, a considerable portion of the county.

The woods of parts of these counties were probably once great forests.

It is noticed, that there is, perhaps, no object in the wood of the latter county, so worthy of attention and observation as the growth of timber; that there is no region of the earth where trees of all kinds thrive better, but especially those of the oak and ash sorts. The tract there distinguished by the title of the Weald has formerly, it is said, been covered with trees, and it was called the forest of Andereida; and that now, even if a field be neglected, it will become a wood, principally of oak and birch, intermixed with hazel, some kinds of willow, and dog wood.

This disposition for the growth and raising of wood and timber should, in all cafes of weald land where it cannot be converted to a better or more profitable purpose, be taken advantage of and promoted, by proper planting and encouraging the natural growth of the wood thrown up, as it may form one great feature in the improvement of such land, and be productive of vast benefit in bringing every portion and fort of it to the greatest profit.

WEALREAP, in our Old Writers, signifies the robbing of a dead man in his grave.

The word comes from the Saxon weal, ßlages, and reaf, spoilatio.

WEANEL, a country term for a young becal newly weaned, or taken from fucking its dam.

WEANING, ABSTRACTATION. See ABSTRACTATION.

Weaning Young Live-Stock, in Rural Economy, the separating them from the mothers in the different kinds, for different purposes, and in different intentions.

Foals, where they are designed for the saddle, should, on being taken from the mothers, be put into some safe sheds or other proper places at a distance, where they can be quiet and out of the hearing of the mares, being well supplied with the necessary forts of food and good water for a day or two; the buildings should be connected with grafts-fields, into which they can be turned in the day-time, but be always brought up for the night, for some time, having proper kinds of dry food then given them in full quantities, so as to get them on well at first. Some intelligent breeders have their young horse-fock fed, after weaning, with coarsely ground oats and one-third flour, divided into proper feeds, and given on the nights in the houfe, This, it is said, helps them on early to a full growth, and that they never become stoutened afterwards. In some instances, it may be useful and proper to put the colt and colt foals into separate pastures. Where a number are to be weaned at a time, it is of advantage to have the pasture-lands pretty large. See BREEDING, FOAL, and HORSE.

In the weaning of the young of neat cattle, the business is accomplished at different times or ages of the animals, as the nature of the purpose for which they are designed may be; when for rearing as flock, it is often done immediately, or in a few days or weeks, and when for fattening, not at all. If for sale, the time is uncertain, depending on the demand. Where good neat cattle-flock is the object, as soon as the natural food milk is laid aside, a substitute of some good fort of diet should be had recourse to, such as oat or barley-meal, stirred in with the jelly of linseed, that has been produced by being steeped in hot water, and mixed with milk; which should be continued until they become capable of eating more firm and solid kinds of food, such as either oats, split beans, and chopped hay, or bran, and barley-flour mixed: in the early spring they should be turned out into good grafs pastures in warm situations. By these means they will be brought on well, and become good strong flock. For the purpose of rearing, as well as that of the butcher, those that are dropped early are to be preferred, as after the early spring months, they are not found capable of gaining sufficient strength and hardnefs before the succeeding winter comes on, or a proper fize and growth by the ensuing spring.

In the buying of the young of neat cattle for weaning there are many syftems of management among farmers: some prefer bull calves for calfration, and which they keep, in some cafes, until they become reared, and are fat bullocks fit for the market; others buy cow-calves of the true short-horned, or some other good milking-breed, which they sell at two years, or two years and a half old, and upwards, to the cowkeepers as milking-flock. In this method, they are collected from the latter end of the summer through the autumn of the above true breed, as others will not do from Yorkshire, and other places where they are to be met with of the right kind, as fuch fell better, and more readily to the cow-keepers for affording milk. In weaning, they are then first put to skim-milk, and tempted as soon as possible to eat some other good food, as bran, oats, oil-cake, the sweettift hay, common turnips, and cole or rape; but nothing is found to do better for them than the Swedish turnip cut small. In keeping them, they should have great attention to cleanliness, and the proper and regular feeding of them. In this way they are continued, being kept in sheds in the night-time, and turned out by day, until the spring, when the ray-grafs becomes ready, and then they may go out gradually altogether, according as the weather may be: after ray-grafs to the beet marhalls or pastures; in the autumn to cole or rape that is feeding off for wheat, and after that to turnips; it is a rule with some to feed them through the whole period of keeping them as well as possible. This is expensive, but it is conceived, that if they will not pay for good keeping, they will not for bad. Some, however, when they are turned out, make them the followers of the fattening flock.

In this system there are theore, too, who buy both cow and bull-calves, disposing of the former in the above manner, and keeping the latter raising a succession of feers for the grazing or fattening farmers.

All these modes, though hazardous in some instances, are often
often very beneficial. A man is required for the purpose, in autumn, winter, and spring, when the busines is carried on upon a large scale. See Calf, Breeding, and Cattle. Also Cow-keeping.

The weaning of lambs is a matter of some trouble and difficulty in many places; it should be done towards the latter end of the summer, according to circumstances, but never be delayed too long, as the ewes may thereby be greatly hurt in different ways. After the lambs are taken, or lifted as it is sometimes called, from the mothers, they should be allowed to pass the night about the fold or place. In the following morning some of them will begin to eat, and teach the others to do the same. They should then be removed to some convenient soft grassy pasture, disturbing them as little as possible, care being taken that they do not waste or exhaust themselves by running. If there be any danger of their not eating quietly the first night after they are removed, it is said that it may be effectually prevented by pinching them with their mothers the night immediately preceding their weaning, on their future pasture, and driving them to the fold or other place directly in that road or way by which the lambs are to be removed from it. In the course of ten or twelve days both the lambs and the ewes may be pastured together again without inconvenience. See LAMP and SHEEP.

Store swine should constantly be weaned at the end of a few weeks, as about six or eight, otherwise they do much injury to the sow. The young sows should be well fed for some time afterwards, in order to push them on to their proper growth, and prevent their becoming dwarfish. The want of attention to this often produces a poor furred fort of pigs, worth little or nothing. See SWINE.

WEANLING, a term applied in some districts to the newly-weaned calf. See WEANING.

WEAPONS. See ARM and ARMOUR.

WEAPON-SALVE, a kind of unguent, supposed to cure wounds sympathetically, by being applied, not to the wound, but to the weapon that made it. See SYMPATHETIC POWDER, and TRANSPLANTATION.

WEAR, or WEER, a great rank, or dam in a river; fitted for the taking of fish, or for conveying the stream to the mill. See FISHING, and WEIR.

WEEL, in Geography. See WEIR.

WEARE, a township of America, in New Hampshire, in the county of Kellborough, containing 2634 inhabitants; 18 miles S.W. of Concord.

WEARING, in SEE LANGUAGE. See VEERING.

WEARY BAY, in Geography, a bay on the N.E. coast of New Holland, S. of Endeavour river.

WEASEL, WEASEL, Common, in ZOOLOGY, a species of the mustela. See Mustela PULGAR.

The common weasel usually resides in cavities under the roots of trees, as well as of banks near rivulets, &c. from which it occasionally falls out in search of birds, and more especially of field-mice, great multitudes of which it detrays.

In Norway, Sweden, Russia, and Siberia, the weasel always changes to white at the approach of winter. In Siberia it is called lagomyska; and the fixus is fold to the Chinese for three or four rubles per hundred.

We have authentic accounts of this animal's being so completely tamed, as to exhibit every mark of attachment to its benefactors, and to be as familiar as a cat or lap-dog. A lady took one of these animals under her protection; and fed it from her hand with warm milk, and also with veal, beef, or mutton. When it was fattened it generally goes to sleep, and when it wakes, it amuses itself with various frolics, and betows the most affectionate carefles on its guardian. It distinguishes the voice of its benefactors amidt twenty people, and gives her a decided preference to all the rest. Among other curious particulars which this lady has related, we cannot forbear mentioning the curiosity of this animal; it being impossible, as she says, to open a drawer or a box, or even to look at a paper, which this little creature will not also examine. Aldrovandus indeed confirms the account given by Buffon; expressly affecting, that weasels are easily tamed, and that, when tame, they are remarkably playful; adding, at the same time from Curdian, that if their teeth are rubbed with garlic, they will not afterwards pre-sume to bite. This writer also affirms, that the weasel sometimes carries her young in her mouth from place to place several times in a day, when the suspects that they will be bled from her: reeling some other animals in this respect. For other species of weasel we refer to Mustela and VIVERRA; and we shall here add some few species, mentioned by Dr. Shaw, which have not been noticed under either of those articles. Such are the viverra Touan, or ferruginous weasel, white beneath, with the tail naked towards the tip, the "Touan" of Buffon; a native of Cayenne, that lives in hollow trees, and feeds on worms and insects. The V. Caja, or black weasel, with turned up snout, the "Caja" of Molina, reeling the ferret in shape, manners, and teeth; a native of Chili, and preying upon mice. The V. Maculata, or dusky weasel, spotted with white; the "Spotted Martin" of governor Phillips, in its form somewhat resembling the foillane. There are also some other species, not yet sufficiently described, as the grey-headed weasel, or "La Grande Marte de Guiane," of Buffon; the South American weasel, or "La Fouine de la Guiane," of Buffon; the woolly weasel, or "La petite Fouine de la Guiane," of Buffon; the musk weasel of Penrall, a native of Bengal; and the slender-toed weasel with a bushy tail, described as well as the other, by Mr. Pennant from a drawing; this latter being a native of Cochinchina.

WEASEL-COAT, in Ornithology, the red-headed finew, or mergus minutus of Linnaeus.

WEATHER, in Agriculture, as denoting the flat or disposition of the atmosphere, in regard to heat and cold, drought and moisture, fog, fair, or foul, wind, rain, hail, frost, snow, and other changes, is a sort of knowledge which is of vast utility and importance to the farmer, as the securing of his different produce in a perfect manner greatly depends upon it; and it is in and by means of the atmosphere, that plants are in some measure nourished, and that animals live and breathe: any alterations or changes in its heat, density, purity, or any other respect, mild, of course, necessarily be attended with proportionable changes in the state of the animal.
WEATHER.

series of years, whence, it is possible, we might be enabled to ascertain and determine the directions, breadths, and bounds of the winds, as well as other matters, and the nature of the weather they bring along with them; with the correspondence there may be between the weather of different places, in divers parts of the earth, and the difference between one fort and another at the same place; and thus, in time, learn to judge of, and for tell many great changes and emergencies; such as extraordinary heats, droughts, rains, f rosts, and some others. But hitherto very few, and only partial accounts in relation to the weather, have been, for the most part, kept. The general conclusions that have been drawn from the experiments that have been made, and the experience had upon this subject, are, that barometers generally rise and fall together, even at very distant places, and a consequent conformity and similiarity of weather; and that this is the more uniformly so, as might be expected, as the places are the nearer together. That the variations of these instruments, too, are the greater, as the places are the nearer to the pole; thus, for instance, the quicksilver in them at London, has a greater range by two or three lines than at Paris, and at that place a greater than at Zurich; and that at some places near the equator, there is scarcely any variation at all; that the rain in Switzerland and Italy is much greater in quantity, taking it for the whole year, than in the county of Essex, though the rains are yet more frequent, or there are more rainy days in that county, than in either of the other places; that cold contributes greatly to rain, and this apparently by condensing the fupended vapours, and thereby making them descend; thus, very cold months, or searsons, are very commonly followed immediately by very rainy ones, and cold summers are always wet ones; that high ridges of country, or mountains, such as the Alps and others, and the snows with which they are covered, not only affect the neighbouring places, but even distant countries, as these often partake of their effects; and the weather is moister rainy in the vicinities of them, both in this and other countries.

The prognostics of the weather that are formed from other circumstances and observations are, that a thick dark sky lasting for some time, without either sun or rain, always becomes fair first and then foul; that is, it changes to a clear sky before it turns to rain. The reason is thought to be obviously this: the atmosphere is replete with vapours, which although sufficient to reflect and intercept the fun's rays from us, yet want density to descend, and while these vapours continue in the same state, the weather will do so too: accordingly such weather is commonly attended with moderate warmth, and with little or no wind to disturb the vapours, but having a heavy atmosphere to sustain them; the barometer being commonly high: but when the cold approaches, and by condensing the vapours, drives them into clouds, or drops, the way is made for the fun-beams to display themselves; until the same vapour, by further condensation, be formed into rain, and fall down in drops. And that a change in the warmth of the weather is often followed by a change in the wind. Thus, the nort hernly and southerly winds, though commonly accounted the contrary of cold and warm weather, are in reality the effects of the cold or warmth of the atmosphere; of which Dr. Derham affirms us he has had so many confirmations, that he makes no doubt of the fact. Thus, it is common to observe a warm southerly wind, suddenly changed to the north, by the fall of snow or hail; or to see the wind in a cold frosty morning north, when the sun has well warmed the air, wheel towards the south, and again turn north e rly or easterly in the cold of the evening.

From the rules laid down by the shepherd of Banbury, many interesting and useful deductions may be made in regard to the weather: it may be concluded, that when the sun rises red and fiery, there will be wind and rain; but that if it rises cloudy, and the clouds soon dispe ar or lessen, there will certainly be fair weather; and that when the evening is red and the morning gray, a fine day may probably be predicted.

That when there are small and round clouds, of a dappled grey colour, with a north wind, it may be determined, that there will be fair weather for two or three days; but that if large clouds like rocks are a sign of great showers. And that when small clouds increase, it is an indication that there will be much rain; but that if the large clouds are seen to lessen, there will be fair weather. In summer or harvest, it may also be considered, when the wind has been south four or three days and it grows very hot, and clouds are seen to rise with great white tops like towers, as if one were on the top of another, being joined together with black on the lower side, a sign that there will be thunder and rain suddenly. And that when two such clouds rise, one on each hand, it is high time to make hale to shelter.

That when a cloud is seen to rise against the wind, or the side wind, it is a sure sign that when the cloud comes near you, the wind will blow the way in which the cloud came. It is the same, too, with the motion of a clear place in the sky, when all the parts of it are thick except one edge. That, at all times, when the clouds look black in the west, it is sure to rain; or if raining, it is sure to continue, whatever quarter the wind may be in: and that, on the contrary, if it should break in the west, it is sure to be fair. That fair weather for a week, with a south wind, is likely to produce a great drought.

That the wind usually turns from north to south quietly, but comes back to north strong and with rain. That sudden rains never last long; but that when the air grows thick by degrees, and the sun, or moon and stars, shine dimmer and dimmer, it is likely to rain for some time.

That when it begins to rain from the south with a high wind for two or three hours, and then the wind falls but the rain continues, it is likely to rain twelve hours or more; and that generally rains until a strong north wind clears the air. But that when it begins to rain an hour or two before fun rising, it is likely to be before noon, and to continue so that day; but that if the rain begins an hour or two after fun rising, it is likely to rain all that day, unless the rainbow be seen before it rains.

That when mists lie in low ground and soon disappear, it is a sign that there will be fair weather; but that when they rise to the hill tops, there will be rain in a day or two.

That a general mist before the fun rises, when near the time of full moon, is a sign of fair weather. That when there are mists in the new moon, there will be rain in the old; and if there are mists in the old moon, there will be rain in the new. That in regard to the mists, as from rain and thunder, when the last eighteen days of the month of February and the first ten days of the following month are for the most part rainy, the sun and thunder may be concluded likely to be so too. It is said also, that a great drought has never been known by the writer, but which began at that time. In respect to the winter, when the end of October and the beginning of the following month are, for the most part, warm and rainy, the two beginning months of the new year are likely to be frosty and cold, except after a very dry
WEATHER.

dry summer. But that when October and the following month are snowy and frothy, the two beginning months of the new year may be likely to be open and mild.

Something may be drawn from the habits, cries, and course of animals, in respect to the weather. It is remarked, that in summer, when sheep rise early in the morning, it is a sure sign of either rain, or a very hot day; and that, in all seafons, when they jump and play much about, it is an indication of rain or wind, but generally of both, in the summer, and of very stormy weather in the winter. That in winter, when the sheep lie under a hedge, and seem loath to go off to pasture, and beat much, it is considered a sign of a storm. And that, when sheep are fed with hay in the winter, and in frothy and snowy weather they leave the hay, it is a certain sign of the frosts breaking up.

That when rabbits get out to feed early in the morning, it is a sign of rain in the night in summer; and of either rain or snow in winter; and when that it is likely to be a bad night, they will be apt to get home before it is dark.

That pigs appear very uneasy before high winds, and run about squeaking as if they were in great pain.

That when owls creech, it is a certain sign of rain, and mostly in a very short time. Also, that when wood-peckers cry, it is a sign of rain. For this reason, they are called, in some places, rain-fowl. That likewise, when wood-peckers cry much, it is a sign of rain. That when the cocks begin to crow while it rains, it is a sign of fair weather.

That before a wet summer, the swans build their nests very high; but that before a dry summer they build very low. That the bitter or bitter bump does the same. But that when the raven is observed early in the morning foaring round and round at a great height in the air, it is a sure sign the day will be fine, and that the weather is likely to be in fair. And that in summer when the bat is seen flying and fitting about very late in the evening, the next day is likely to be fair. That likewise, when the swallow is observed to fly high, the weather will most likely be warm and fair. But that when it is noticed to fly low, and dip the tips of its wings in the water as it skim over the surface, the weather is likely to be rainy. And that the continued squalling of the guineas-fowl, and the quacking of ducks and geese, are certain signs of rain.

That before great storms the miffel thrush sings particularly loud, and continues to do so until the rain begins. On this account, in some places, it is called the storm-fowl. Also, that in autumn, when rocks of wild geese are seen flying over in a westerly direction, it is a sign there soon will be hard weather. That the early appearance of the wood-cock and field-fare likewise indicate cold hard winters.

That when in the time of hay-making the black flies are to be seen fretted along on the swath of grass, it is a sign of rain. That when frogs look black instead of a golden yellow colour, it is a sign of rain. And the loud hoarse croakings of frogs are sure signs of rain.

That in autumn, when the dor beetle is seen flying about in the evening, the next day is likely to be fine. Also, that when bees do not go out as usual, but keep in their hives, it is a sign of rain. Much information of this nature may be found in Marshall's "Minutes of the Southern Counties," which may be confulted by the cautious farmer with great utility and advantage, in regard to the weather he may have for securing his produce in different cases.

There are other conclusions, too, in respect to the weather, that may be drawn from plants of different kinds, as mott vegetables expand their flowers and down in fun-fothy weather; and towards the evening and against rain clothe them up, especially at the beginning of their flowering, when the seeds are sensible and tender. This is visible and evident enough in the down of dandelion, and many other downs, and eminently so in the flowers of pimpernel; the opening and shutting of which make what is termed the countryman's weather-wiser, by which he foretells the weather of the following day. The rule is, when the flowers are close shut up, it betokens rain and foul weather; but when they are open and abroad fair weather. And lord Bacon observes, that the flails of trefoil swell against rain, and grow more upright; and that the like may be noticed, though less sensibly, in the flails of most other plants. It is added, too, that in the flabile fields there is found a small red flower, called by the country people pimpernell, which opening in a morning is a sure indication of a fine day.


It is readily conceivable that vegetables should be affected by the same causes as the weather, as they may be considered as so many hygrometers and thermometers, consisting of an infinite number of tracheas or air-veilfs, by which they have an immediate communication with the air or atmosphere, and partake of its moisture, heat, and other changes. And hence, too, it is, that all wood, even the hardet and mott fold, swells in moist weather, the humid vapours easily infiltrating themselves into the pores of it, especially of the lighter and drier kinds, from which they become applicable to many purposes of art, and may tend to the change of the weather in some influences.

Hence we derive a very extraordinary use of wood, viz. for breaking rocks for mill-stones.

The method at the quarries is this:—Having cut a rock into a cylinder, they divide that into several flat cylinders, by making holes at proper distanes round the great one; the holes they fill with so many pieces of fallow wood, dried in an oven, which, in moist weather, becoming impregnated with the humid corpuscles of the air, swell and, like wedges, break or cleave the rock into several stones.

The attentive farmer should score up in his mind as many of the useful rules relating to the weather as possible, as they may serve him very effectually, on many occasions, in the performance of his various busines. See Atmospheric, Meteorology, Heat, Rain, Wind, &c.

The members of our Royal Society, the French Academy of Sciences, and many authors of note, have made considerable essays this way; and the practice of keeping meteorological journals has, of late years, become very general. For instructions and examples pertaining to this subject, see Phil. Trans. vol. lxx. part ii. art. 16.

Eras. Bartholin has observations of the weather for every day throughout the year 1671. Mr. W. Merle made the like at Oxford, for seven years, with a very remarkable care and accuracy. Dr. Pott did the same at the same place, for the year 1684. Mr. Hillier, at Cape Corfe, for the years 1686, 1687. Mr. Hunt, &c. at Greatham college, for the years 1695, 1696. Dr. Derham, at Upminster in Essex, for the years 1691, 1692, 1697, 1698, 1699, 1703, 1704, 1705. Mr. Townley, in Lancashire, in 1697, 1698. Mr. Cunningham, at Emin in China, for the years 1698, 1699, 1700, 1701. Mr. Locke, at Oats in Essex, 1692. Dr. Schenckzer, at Zurich, in 1708; and Dr. Tilly, at Pfaff, the same year. See the Phil. Transactions.

The form of Dr. Derham's observations we give as a specimen of a journal of this kind; observing that he notes the...
WEATHER.

the strength of the winds, by $\theta$, $1, 2, 3$, &c. and the quantity of rain, as it fell through a tunnel, in pounds and centeminals.

Phenomena of the Weather, October 1697.

<table>
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<tr>
<th>Day</th>
<th>Hour</th>
<th>Weather</th>
<th>Wind</th>
<th>Barometer</th>
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We have several schemes for keeping meteorological journals or diaries of the weather, extant in the Philosophical Transactions, the Medical Essays of Edinburgh, and in other books. The Pleterides Ultrajectina may also be consulted. The instruments requisite for such journal are, a Barometer, Thermometer, Anemoscope, and Ombrrometer, which see in their proper places. See a Collection of ingenious observations, and meteorological conjectures, by Dr. Franklin, in his Experiments, &c. p. 182, &c. See EVAPORATION, RAIN, AND WIND.

We shall here specify some of the common indications of changes of weather that may be observed at sea. Under the article Tides we have already stated, that they are raised by the joint actions of the sun and moon; the spring-tides being raised by the sun, and the neap-tides by the difference of the actions of these bodies: and, also, that the spring-tides, near the time of an equinox, are higher than at other times of the year. Now, since the atmosphere is a fluid much lighter than water, it must, therefore, be more affected about the times of new and full moon, an alteration in the state of the weather usually happens: and the violent gales about the time of the equinoxes, called equinoctial gales, are well known, and expected by every seaman.

According as the state of the atmosphere is more or less disturbed, it is evident the appearance of the heavenly bodies will be more or less altered. Thus, if the moon appears paler than usual, or if there is a halo about the moon, rain will probably follow soon after. Several circles about the moon indicate wind. These observations are also applicable to the sun. If the moon appears of a red colour, or if the moon’s horns are blunt, they are signs of wind, which may be expected from that quarter to which the blunted horn is directed. In viewing the moon with a telescope in a quiet evening, if one part of the moon’s limb be observed to be treasured, while the opposite part of the limb is without the least apparent tremor, the wind may be expected from that point to which the limb free of tremors is directed. A red circle about the moon towards the time of full moon indicates wind.

One of the best known signs in the heavens is the Rainbow; which see. When the blue and yellow parts of the rainbow are very bright, or if all of it vanish at the same time, it will be fair weather: if the bow appears to be broken in several places, tempestuous weather may be expected.

From the various appearances of the clouds, (see Clouds,) which are vapours floating in the atmosphere, producing rain, hail, snow, thunder, and lightning, the approaching weather may, in some measure, be predicted. The height of the clouds seldom exceeds a mile; and the summits of high mountains are free of clouds.

When the sky is of a fine blue colour, without any clouds, it will continue to be fair weather; but if it is of a very dark blue, clouds will be formed, and rain, wind, or fog, will soon follow.

When the sky appears very much clouded for some time, without rain, it generally first clears up, and then changes to rain. This is accounted for as follows:—The atmosphere at that time being repelled with vapours, which, though sufficient to intercept the rays of the sun, yet want density to descend; and while the vapours continue in the same state, the weather will do so too; and such weather is commonly attended with moderate warmth, and with little or no wind to disturb the vapours, and an heavy atmosphere to support them, the barometer being commonly high. But when the cold approacheth, and, by condensing the vapours, drives them into clouds or drops, then way is made for the fun-beams, till the same vapours, by farther condensation, be formed into rain, and fall down in drops.

If the clouds, in a summer evening, gradually diminish, and at last vanish, it will be fine weather; but, if they increase, and small clouds be observed to move very swiftly underneath, it will be rain soon after; or, if the clouds change to a dark colour, thunder may be expected.

If the clouds in the western hemisphere, at the time of sun-set, are tinged with a light red and yellow; or, if there are no clouds, and the sky, towards that part of the horizon where the sun sets, be of a beautiful red and yellow, it will be fine weather: but if the sun be of a pale colour, or if the clouds change to a dark red, and continue, it will be rain. The clouds tinged with a dark red in the opposite hemisphere to the sun, whether at rising or setting, presage wind.

In winter, when large clouds are observed with white edges, and a strong blue sky above them, it will be hail or snow; or probably these may be dissolved into rain before they reach the earth.

When there are two or more strata of clouds moving in different directions, rain generally follows. Many small clouds, pretty high, and other appearing at the same time in form of fleeces of wool, denote wind. A cloud of an oblong form, sometimes called Noah’s Ark, seen in a clear sky, and changing from a fine light to a dark colour, is a sign of rain; but, if it changes from dark to light, it is a sign of fair weather.

A small black cloud seen in a clear sky, or several small clouds collecting near each other, are an indication of wind from the quarter from whence they are observed to move: also, if the clouds are observed to diverge from a point in the horizon, wind may be expected from that, or from the opposite point.

When flares of the second and third magnitudes are suddenly obscured, wind or rain will soon follow. Those meteors, commonly called falling or shooting stars, are usually the forerunners of wind.

That appearance in the heavens resembling a portion of the rainbow, but apparently broader than any part of the arch when complete, and generally known by the name of a Windgall, is an indication of an approaching gale.

The Aurora Borealis, (which see,) or northern light, is a sign of wind from between the S, and S.W. points; attended with hazy weather, and small rain, the gale generally commencing between twenty-four and thirty hours after the first appearance of the aurora. The violence of the gale, and the time of its commencement after the aurora borealis is seen, and duration, depend, in a great measure, upon the brightness and motion of the aurora; for the more brilliant the aurora, and the quicker its motions, the gale will happen sooner, be more violent, and of shorter duration.

A change
A change in the wind commonly produces a change in the weather. Thus, in fair weather, if the wind changes to the opposite point, rain may be expected; but, in rainy or foggy weather, it will clear up soon after the change of the wind.

In a storm at sea, a fiery meteor, in form of a ball, affording an obscure flame like a candle burning faintly, is sometimes seen adhering to the masts, yards, &c. or leaping from one part to another. When only one is seen, it is called Helen, and is a sign that the severest part of the storm is yet to come. When two are observed, they are called Calor and Pallas, and sometimes Tyndarides, and denote the storm to be near an end. If five of these balls are seen together, which the Portuguese call the Virgin Mary's Crown, it is considered to be a sure sign that the storm will soon over. When the meteor adheres to the masts, yards, &c. it is concluded, from the air not having sufficient motion to dissipate the flame, that a calm will soon ensue; but if it leaps from one place to another, that it denotes a storm.

At the Cape of Good Hope, an approaching storm, or gale of wind, is easily known by the following observations:—When a small black cloud, called the Ox-eye, is observed to rise from the top of Table Mountain, which continues to increase until the heavens be almost entirely overclouded, the storm then commences. A similar phenomenon usually precedes a storm at the Arabian gulf: this storm comes from the north, and is accompanied with a great quantity of red sand.

When a hurricane happens in the West Indies, it is generally either at new or full moon, or at the quarters, and the signs are as follow:—The sun and moon appear redder than usual, and are sometimes surrounded with a halo; the stars at night appear larger and fainter. The sky in the N.W. quarter is dark; the hills are clear of those clouds and mists which usually hover about them; the sea emits a strong smell, and is violently agitated, often when there is no wind; the wind also veers about the west, from whence it sometimes blows with intermissions violently and irregularly for about two hours at a time.

The tumbling of porpoises indicates a gale of wind. When a swell sets from any particular point, there being no wind, a gale may be soon expected from that point.

From a very great number of meteorological observations, made in England between the years 1677 and 1789, Mr. Kirwan has deduced the following probable conjectures of the weather:

1. That when there has been no storm before or after the vernal equinox, the ensuing summer is generally dry, at least six times in fix.
2. That when a storm happens from any easterly point, either on the 19th, 20th, or 21st of March, the succeeding summer is generally dry, four times in five.
3. That when a storm occurs on the 25th, 26th, or 27th of March, and not before, in any point, the succeeding summer is generally dry, four times in five.
4. If there be a storm on S.W. or S.S.W. on the 19th, 20th, 21st, or 22nd of March, the succeeding summer is generally wet, four times in five.

We shall further subjoin the following observations:

1. A moist autumn, with a mild winter, is generally followed by a cold and dry spring, which greatly retards vegetation.
2. If the summer be remarkably rainy, it is probable that the ensuing winter will be severe; for the mutual evaporation will have carried off the heat of the earth. Wet summers are generally attended with an unusual quantity of

feed on the white thorn and dog-rose bushes. Hence, the unusual fruitfulness of these shrubs is a sign of a severe winter.

3. The appearance of cranes, and birds of passage, early in autumn, announces a very severe winter; for it is a sign that it has already begun in the northern countries.

4. When it rains plentifully in May, it will rain but little in September, and vice versa.

5. When the wind is S.W. during summer or autumn, and the temperature of the air unusually cold for the season, both to the feeling and the thermometer, with a barometer, much rain is to be expected.

6. Violent temperatures, as storms or great rains, produce a sort of crinids in the atmosphere, which produces a conflagrant temperature, good or bad, for some months.

7. A rainy winter predicts a fruitful year; a severe autumn announces a windy winter.

For indications of the weather by the barometer, see BAROMETER. By the Thermometer, (which see,) Mr. Dalton deduces the following conclusions:

The mean altitude of the mercury in the thermometer in Britain is about 55°: if higher, the weather is warm; but if lower, it is cold.

A quick and considerable alteration in the altitude of the mercury in the thermometer indicates rain.

If it begins to snow when the thermometer is below 32°, the mercury generally rises to that altitude, and continues while the snow falls. If the weather clears up soon after, a severe cold may be expected. See also HYGROMETER, from which it is inferred, that, when the index of the hygrometer points to dry, and continues proceeding towards extreme dryness, fair weather, and probably wind, may be expected; but if the index returns to the meanflate, it will be rain. If the index points to moist and increasing, rain will soon follow; if it returns towards the mean, it will be fair weather.

As to the supposed influence of the moon upon the weather, see InNFlUENCE OF THE MOON.

WEATHER, in Sea Language, is used as an adjective, and applied by mariners to every thing lying to windward of a particular situation: thus, a ship is said to have the weather-gage of another, when she is farther to windward. Thus also, when a ship under fail preys either of her sides to the wind, it is then called the weather-side, or weathervard; and all the rigging and furniture situated on it are distinguished by the fame epithet; as the weather-swahds, the weather-lifts, the weather-braces, &c.

To WEATHER, is to fall to windward of some ship, bank, or head-land.

WEATHER-Beat. Scattered by a storm.

WEATHER-Bit, denotes a turn of the cable of a ship about the end of the windlass, without the knight-heads. It is used to check the cable, in order to slacken it gradually out of the ship, in tempestuous weather, or when the ship rides in a strong current. See RING-Keeper.

WEATHER-Boarding, among Carpenters, &c. denotes the nailing up of boards against a wall, and sometimes the boards themselves when thus nailed up.

WEATHER-Cock, or WEATHER-Vane, a moveable vane, in form of a cock, or of other shape, placed on high, to be turned round according to the direction of the wind, and point out what quarter the wind blows from. See VANE.

WEATHER-Cord. See HYGROMETER.

WEATHER-Hard-a. See HARD.

WEATHER-House. See HYGROMETER.
WEATHER-Gage, in Sea Language. When a ship or fleet is to windward of another, she is said to have the weather-gage of her.

Weather-Gla\es are instruments contrived to indicate the state or disposition of the atmosphere, as to heat, cold, gravity, moisture, &c. to measure the changes befalling it in these respects; and by these means to predict the alteration of weather, as rains, winds, snow, &c.

Under the class of weather-gla\es, are comprehended barometers, thermometers, hygrometers, manometers, and anemometers, of each of which there are divers kinds. See their theories, constructions, uses, kinds, &c. under Barometer, Thermometer, Hygrometer, &c.

Weather-Quarter, in Sea Language, that quarter of the ship which is on the windward side.

Weather-Quoil or Coile, is the turning of the ship's head about, so as to lie that way which her stern did before without loosing any fail, but only by bearing up the helm.

Weather-Side, the side of a ship upon which the wind blows.

Weather-Shore, a name given to the shore lying to windward.

Weather- Tilting, in Building, the covering of the up-right fide of a house with tiles.

Weatherer, in Geography, one of the smaller Shetland islands. N. lat. 60° 33'. W. long. 1° 13'.

Weathering, a doubling, or failing by a point, or place.

Weathering, among Mill-wrights. See Wind-Mill.

The Weathering of a Hawk, among Falconers, is the setting of her abroad to take the air.

Weatherfield, in Geography, a town of the state of Connecticut, in the county of Hartford, founded about the year 1639, containing 2868 inhabitants; 5 miles S. of Hartford.—Allo, a township of Vermont, in the county of Windor, containing 2115 inhabitants; 3 miles S. of Windor.—Allo, a town of Ohio, in the county of Trumbull, containing 232 inhabitants.

Weaver, in Manufactures, one who practises the art of weaving.

Persists using the trade of a weaver, shall not keep a tucking or fulling-mill, or use dyeing, &c. or have above two looms in a house in any corporation or market-town, on pain of forfeiting 20l. a week; and shall serve an apprenticehip for seven years to a weaver or clothier, or shall forfeit 20l. &c. 2 & 3 Ph. & M.

Weaver's Alarm. This contrivance is only a weight fastened to a packthread, which is placed horizontally, so that in a certain time a candle may burn down to it. Then the flame of the candle setting fire to the thread, the weight falls, and awakens the sleeping person. See Phil. Trans. No. 477. sect. 14, where we have a figure to explain the invention, which has got its name from being in frequent use among the weavers.

Weaver's Lake, in Geography, a lake of New York; 3 miles N.W. of Otsego lake.

Weaving, in Manufactures, is the art of combining and uniting threads together, to form cloth. Stocking-knitting or weaving is a distinct art from cloth-weaving, the manner of combining the thread, being essentially different in the two. In the stocking fabric, the whole piece consists of a continuous thread, which is formed into a series of loops in successive rows; and the loops of each row are drawn through the loops of a former row. See Stocking-Frame.

Woven cloth is always composed of two distinct systems of threads, called the warp and the weft: these traverse the piece of cloth in opposite directions, and are usually at right angles to each other. These threads, (or, as the weavers call them, yarns,) which run in the direction of the length of the web or piece of cloth, are called the warp, and they extend entirely from one end of the piece to the other. The cross thread, or yarn, runs across the cloth, and is called the woof or weft. This is in fact one continued thread through the whole piece of cloth, being woven alternately over and under each yarn of the warp, which it crosses, until it arrives at the outside one. It then passes round that yarn, and returns back over and under each thread, as before; but in such a manner, that it now goes over those yarns which it passed under before, and vice versa; thus firmly knitting or weaving the warp together. The outside yarn of the warp, round which the woof is doubled, is called the selvage, and cannot be unravelled without breaking the weft. The strength of the cloth, in the direction of the length, must depend on the threads of the warp; but its strength in the opposite direction will depend upon the weft; and the strength of these two threads should be always properly proportioned to each other.

The combined arts of spinning and weaving are among the first essentials of civilized society, and we find both to be of very ancient origin. The fabulous story of Penelope's web, and, still more, the frequent allusions to this art in the sacred writings, tend to show, that the fabrication of cloth from threads, hair, &c. is a very ancient invention. It has, however, like other useful arts, undergone a vast succession of improvements, both as to the preparation of the materials of which cloth is made, and the apparatus necessary in its construction, as well as in the particular modes of operation by the artificer. When reduced to its original principle, is nothing more than the interlacing of the weft or cross threads into the parallel threads of the warp, so as to tie them together, and form a web or piece of cloth. This art is doubtless more ancient than that of spinning, and the first cloth was what we now call matting, i.e. made by weaving together the shreds of the bark, or fibrous parts of plants, or the flax, such as rufhies and flours.

This is still the substitute for cloth among most rude and savage nations. When they have advanced a step further in civilization than the flate of hunters, the skins of animals become scarce, and they require some more artificial subsistence for clothing, and which they can procure in greater quantities. Nevertheless, some people are still ignorant of the art of weaving; for the cloth made in the islands of the South seas appears to be made by cementing or gluing the threads together, rather than by weaving. From the description given by captain Cook, and other circumnavigators, and from the specimens which have been brought to Europe, their cloth, or rather matting, is in general produced by cohesion of the parts, rather than texture. This assimilates it more to the ideas which we attach to paper, or pasteboard, than to those which we form of cloth.

When it was discovered that the delicate and short fibres, which animals and vegetables afford, could be so firmly united together by twisting, as to form threads of any required length and strength, the weaving art was placed on a permanent foundation. By the process of spinning, which was very simple in the origin, the weaver is furnished with threads far superior to any natural vegetable fibres in lightness, strength, and flexibility; and he has only to combine them together in the most advantageous manner.

The art of weaving cloth has been so extensively applied
WEAVING.

in almost every civilized country, and the knowledge of its various branches has been derived from such a variety of sources, that no one person can ever be practically employed in all its branches; and though every part bears a strong analogy to the rest, yet a minute knowledge of each of these parts can only be acquired by experience and reflection. We will endeavour to give the reader a comprehensive idea of the history and progress of this ancient and invaluable art as the nature of the thing, and the limits to which we are necessarily confined, will permit.

The history of this art is very little known, and its great antiquity necessarily involves the earlier eras of it in the most perfect obscurity.

The art of making linen, which was probably the first species of cloth invented, was communicated by the Egyptians, the inhabitants of Palestine, and other eastern nations, to the Europeans. By slow degrees it found its way into Italy; and it afterwards prevailed in Spain, Gaul, Germany, and Britain. The Belgae manufactured linen on the continent; and when they afterwards settled in this island, it is probable they continued the practice, and taught it to the people among whom they resided.

When it is considered that the wants of mankind are nearly the same in all countries, it is not improbable that the same arts, however varied in their operations, may have been separately invented in different countries. It is not, however, certain that the art of making cloth is one which the Britons invented for themselves.

It is most probable that the Gauls learned it from the Greeks, and communicated the knowledge of it to the people of Britain. It is very certain that the inhabitants of the southern parts of Britain were well acquainted with the arts of dressing, spinning, and weaving, both flax and wool, when they were invaded by the Romans. Nevertheless, we have the authority of Julius Caesar, that when he invaded Britain, the art of weaving was totally unknown to the Britons.

Whatever knowledge the Britons might possess of the clothing arts, prior to the invasion, it is very certain that these arts were much improved amongst them after that event. It appears from the Notitia Imperii, that there was an imperial manufactury of woollen and linen cloth, for the use of the Roman army then in Britain, established at Venta Belgarum, now called Winchester.

Many public acts relative to the woollen manufacture, in the earlier period of English history, evidently prove that the greater part of our wool was, for a very long series of years, exported in a raw state, and manufactured upon the continent.

In bishop Aldehamp’s book concerning “Virginity,” written about A.D. 680, it is remarked, “that chastity alone forms not a perfect character, but requires to be accompanied and beautified by other virtues.” This observation is illustrated by the following simile, borrowed from the art of figure-weaving: “It is not a web of one uniform colour and texture, without any variety of figures, that pleaseth the eye, and appeareth beautiful; but one that is woven by shuttles, filled with threads of purple, and many other colours, flying from side to side, and forming a variety of figures and images, in different compartments, with admirable art.”

Perhaps the most curious specimen of this ancient figure-weaving and embroidery, now to be found, is that preserved in the cathedral of Bayeux. It is a piece of linen, about 19 inches in breadth, and 67 yards in length, and contains the history of the Conquest of England by William of Normandy; beginning with Harold’s embassy, A.D. 1065, and ending with his death at the battle of Hastings, A.D. 1066. This curious work is supposed to have been executed by Matilda, wife to William, duke of Normandy, afterwards king of England, and the lady of her court. Although it is certain that the art of figure-weaving was then known in Britain, it must be owned, that the piece of tapestry just mentioned owes most of its beauty to the exquisite needle-work with which it is adorned.

The silk manufacture was first practised in China, and the cotton in India. Both the woollen and linen were borrowed by the English from the continent of Europe; and for many ages, all the improvements in them in this country were first introduced into this country by foreign artificers, who settled amongst us.

About the close of the eleventh century, the clothing arts had acquired a considerable degree of improvement in this island. About that time, the weavers in all the great towns were formed into guilds or corporations, and had various privileges bestowed upon them by royal charters.

In the reign of Richard I., the woollen manufacture became the subject of legislation; and a law was made A.D. 1197, for regulating the fabric and sale of cloth.

The number of weavers, however, was comparatively small, until the policy of the wife and liberal Edward III., encouraged the art, by the most advantageous offers of reward and encouragement to foreign cloth-workers and weavers, who would come and settle in England. In the year 1331, two weavers came from Brabant, and settled at York.

The superior skill and dexterity of these men, who communicated their knowledge to others, soon manifested itself in the improvement and spread of the art of weaving in this island.

Many Flemish weavers were driven from their native country, by the cruel persecutions of the duke d’Alva, in the year 1567. They settled in different parts of England, and introduced or promoted the manufacture of baizes, ferges, crapes, and other woollen stuffs.

About the year 1686, nearly 50,000 manufacturers, of various descriptions, took refuge in Britain, in consequence of the revocation of the edict of Nantes, and other acts of religious persecution committed by Louis XIV. These improvements chiefly related to silk-weaving.

The arts of spinning, throwing, and weaving silk, were brought into England about the middle of the 15th century, and were practised by a company of women in London, called silk-women. About A.D. 1480, men began to engage in the silk manufacture, and the art of silk-weaving in England soon arrived at very great perfection. See Silk.

The civil condition which followed this period, retarded the progress of these arts; but afterwards, when the nation was at rest, the arts of peace, and among others that of weaving, made rapid advances in almost every part of the kingdom.

In the latter part of the last century, the invaluable inventions of sir Richard Arkwright, introduced the very extensive manufacture of cotton, and added a lucrative and elegant branch of traffic to the commerce of Britain. The light and fanciful department of the cotton manufacture has become, in some measure, the staple manufacture of Scotland, whilst the more substantial and durable cotton fabrics have given to England a manufacture superior, in importance and extent, only to the woollen trade.

At the present day, our superiority in point of quality
is universally acknowledged in the cotton manufacture; but in those of silk, linen, and woollen, it is still disputed by other countries.

_Weaving._—Weaving is performed by the aid of a machine called a loom. The common loom for plain cloth is a very simple machine; but some of the varieties which are used for weaving ornamental and figured cloth are very curious; still there are parts common to all. The principal of these are as follows.

1. The yarn-beam, which is a round wooden roller, on which is wound or rolled the warp, or yarns that are to form the length of the piece of cloth. 2. The cloth-beam is a similar roller, on which the cloth is rolled up when woven. The yarns of the warp are extended in parallel lines, between the yarn-roll and the cloth-roll, so as to form a horizontal plane, or sheet, and are combined together by the cross-threads, or weft. 3. The shuttle, which has a hollow to contain a bobbin or pin of the weft. 4. The heddles, which are threads with loops or eyes, through which the yarns of the warp pass: the heddles are connected with the treadles, upon which the weaver places his feet, to draw down one set of heddles and raise up another, so as to open and separate the warp into two divisions, and allow a passage, called the shed, for the shuttle between them. 5. The reed, which is a frame containing a row of parallel shreds of reeds or cane, and the yarns of the warp pass between them, as it were between the teeth of a comb. 6. The reed is fixed in a frame, called the loom or lathe, which sways upon centres of motion. The use of the reed and lathe is to comb or pull the threads of the weft close to each other, and make the cloth close and dense.

The operation of weaving or working the loom for plain cloth consists of three very simple movements, viz. 1. Opening the shed in the warp alternately, by preffing the two treadles with his feet in opposite directions. 2. Driving or throwing the shuttle through the shed when opened. This is performed by the right-hand, when the fly-shuttle is used, and by the right and left alternately, in the common operation, wherein the shuttle is thrown from one hand and caught in the other. 3. Pulling forward the lay or batten to strike home the weft, and again pulling it back nearly to the heddles. This is done by the left-hand with the fly-shuttle, or by each hand successively in the old way.

There are several different ways of setting up a loom for weaving plain cloth; but the principal parts are always made the same. We shall first describe that which is used for weaving plain silks: it is shewn in perspective in Plate II. Weaving. In this A is the yarn-roll or beam, on which the thread to form the warp is regularly wound; B, the cloth-beam, or breast-roll, on which the finished cloth is wound up; D E, the treadles, on which the weaver presses his feet; d d, e e, are the heddles, or harnesses. These are each composed of two small rods d d and e e, connected together by several threads, forming a system of threads, which is called a heddle; e e is another heddle, behind the former. In the middle of each thread of the heddle is a loop, through which a yarn of the warp is passed, every other yarn going through the loops of the heddle e e, and the intermediate yarns passing between the threads of that heddle, and afterwards through the eyes or loops of the other heddle d d.

The two heddles, d d and e e, are connected together by two large cords going over pulleys, suspended from the top of the loom, so that when one heddle is drawn down, the other will be raised up. The heddles receive their motion from the levers or treadles D E, moved by the weaver's feet. The yarns of the warp being passed alternately through the loops of the two heddles, by preffing down one heddle, as E, all the yarns belonging to the heddle e e are drawn down; and by means of the cords and pulleys, the other heddle d d, with all the yarns belonging to it, are raised up; leaving a space, called the shed, of about two inches between the yarns, for the passage of the shuttle.

F, G G, H, (fig. 2,) is a frame, called the batten or lay, suspended by the bar F, from the upper rails of the loom, so that it can swing backwards and forwards, as on a centre of motion; the bottom bar H is much broader than the rails G G, and projects before the plane about an inch and a half, forming a shelf, called the shuttle-race. The ends of the shuttle-race H have boards nailed on each side, to form two short troughs or boxes I I, in which pieces of wood or thick leather are, called peckers or drivers, traverfing. The peckers are guided by two small wires, fixed at one end to the uprights G G, and at the other to the end-pieces of the troughs I I. Each pecker has a string fastened to it, tied to the handle y, which the weaver holds in his right-hand when at work, and with which he pulls, or rather snatchs, each pecker either to the right or left alternately. R is the reed: it is a small frame, fixed upon a shuttle-race H, containing a number of small pieces of split reeds or canes; or else pieces of flat wire, of steel or brass; but the cane is most common, although the frame is called the reed. When fig. 2, is in its place in the loom, the yarns of the warp pass between the canes or dents of the reed. In fig. 2, the reed is represented without the top or piece which covers it, and which is called the lay-cap. It is a rail of wood with a longitudinal groove along its lowermost side, for the purpose of sustaining the upper edge of the reed. The lay-cap is that part of the machine on the middle of which the weaver lays hold with his left-hand when in the act of weaving.

The shuttle (see Plate I,) is a small piece of wood pointed at each end, from three to six inches long. It has an oblong mortise in it, containing a small bobbin or pin, on which is wound the yarn which is to form the weft; and the end of this yarn runs through a small hole in the shuttle, called the eye. The shuttle has two little wheels on the under side, by which it runs easily upon the shuttle-race H.

Operation.—The weaver fits on the seat M, (fig. 1,) which hangs by pivots at its ends, that it may adapt itself to the eafe of the weaver when he fits upon it. It is lifted out when the weaver gets into the loom, and he puts it in again after him. He leans lightly against the cloth-roll B, and places his feet upon the treadles D E. In his right-hand he holds the handle y, (fig. 2,) and by his left he lays hold of the rail, called the lay-cap, which crosses the batten or lay G G, and serves to support the upper edge of the reed R. He commences the operations by preffing down one of the treadles with his foot; this deprefles one-half of the yarns of the warp, and rafhes the other, as before described. The shuttle is previously placed in one of the troughs I I, against the pecker K, belonging to that trough. By the handle of the pecker, with a sudden jerk, he drives the pecker against the shuttle, so as to throw it across the warp upon the shuttle-race, into the other trough I I, leaving the yarn of the weft, which was wound on the bobbin after it, in the space between the divided yarns. With his left-hand he pulls the lay towards him; and, by means of the reed, the yarn of the weft, which before was lying loose between the warp, is driven up towards the
the cloth-roll: the weaver now pulls down his other foot, which reverses the operation, pulling down the heddle which was up before, and raising that which before was depressed. By the other pecker he then throws the shuttle back again, leaving the wool after it between the yarns of the warp; and, by drawing up the batten, beats it close up to the thread before thrown.

In this manner the operation is continued until a few inches are woven; it is then wound upon the cloth-roll, by putting a short lever into a hole made in the roll, and turning it round, a click acting in the teeth of a ferrated wheel, prevents the return of the roll. At each end of the yarn-roll A, (fig. 1.) a cord is tied to the frame of the loom; the other ends of the cords have weights hanging to them. The rope causes a friction, which prevents the roll from turning (unless the yarn is drawn by the cloth-beam), and always preserves a proper degree of tension in the yarn.

T T (fig. 1.) are two smooth sticks (cotton-weavers have usually three,) put between the yarns, to preserve the loofe, and keep the threads or yarns from entangling.

In cotton-weaving these sticks or rods are kept at an uniform distance from the heddles, either by tying them together, or by a small cord with a hook at one end, which lays hold of the front rod, and a weight at the other, which hangs over the yarn-beam. The cloth is kept extended during the operation of weaving, by means of two hard pieces of wood, called a templ, with small sharp points in their ends, which lay hold of the edges, or selvages, of the cloth.

These pieces are connected by a cord passing obliquely through holes, or notches, in each piece. By this cord they can be lengthened or shortened, according to the breadth of the web.

They are kept flat after the cloth is stretched by a small bar turning on a centre fixed in one of the pieces of wood. This stretcher is called the templ. Silk-weavers usually stretch their cloth by means of two small sharp-pointed hooks fastened to the ends of two strings, with little weights at the other ends; and the strings are made to pass over little pulleys in each side of the loom, at a suitable distance from the selvages of the cloth.

The perfection of the work depends very much upon the previous operations which the yarn must undergo. It is obvious that the yarns of the warp must be stretched with great parallelism and equality of tension, so that when the cloth is finished, every individual yarn may bear an equal share of any strain which tends to tear the cloth; hence great care must be taken to stretch the yarns of the warp to an equal length, and roll them with great regularity upon the yarn-roll. These operations are called warping and beaming. Previous to warping, the yarn must be prepared by fizing or flatching, in order to cement all the loose fibres, and render the yarn smooth.

The spinners of yarn, whether they employ machinery or not, usually reel the yarn into skeins and hanks of a determinate length; and the weight of these hanks, or the number which will weigh one pound, is the denomination for the fines of the yarn. (See Manufacture of Cotton.) In this state the yarn is bought by the weaver. The hanks of yarn are first boiled in water; if it is linen-yarn a little soap and potash are put into the water, and for cotton-yarn a small portion of flour is added, to render the thread firm. When the hanks are perfectly dry they are wound off upon bobbins, each thread having a separate bobbin, and a certain length is wound upon each. This winding is performed by a very simple hand-wheel to turn the bobbin rapidly round, the hanks of yarn being extended upon a reel, or over two small reels placed at a distance asunder, which are called wicks.

Warping.—The object of this operation is to stretch the whole number of parallel threads which are to form the warp of the cloth to an equal length. For this purpose as many as the above bobbins are taken as will furnish the quantity of threads which is required in the warp of the piece of cloth. The bobbins are usually one-fourth or one-fifth of the number of threads required, and are mounted on spindles in a frame, so that the thread can draw off freely from them. All these threads are drawn off at once, so as to combine them all into one clve, which will be ready for the warp. The ancient method was to draw out the warp to full length, and stretch it in a field; and this is still practiced in India and China, but is so very uncertain in our climate that it is seldom used. The present mode of warping is either by the warping-frame or warping-mill.

The warping-frame is a large wooden frame, which is fixed up against a wall in a vertical position. The upright sides of the frame are pierced with holes to receive wooden pins, which project sufficiently to wind the clve of yarn for the warp round them.

The operator having the threads which are to compose the warp wound on the bobbins before-mentioned, places these bobbins in a frame; then tying the ends of all the threads together, and attaching them to one of the pins at one end of the frame, he gathered all the threads in his hand into one clve; and permitting them to slip through his fingers, he walked to the other end, where he passed the yarn over the pin fixed there, and then returned to the former end of the frame and passed the warp over another pin, then went back again, and so on till he formed the required length of the warp. This being done, he secured the end of the warp by crossing it round the pin, and then he worked back and returned over all the same space again, laying the threads over the same pins, so as to double the clve; and he repeated the doubling until the number of threads necessary for the breadth was made up. The number of doublings would be according to the number of bobbins and threads which he took in his hand at once.

This method is used very much in France, particularly at Lyons: it is also used in Devonshire. It is adapted to the weaving carried on in cottages, because the frame is fixed close to the wall, and takes little or no room; but the warping-mill or reel is very superior, and is adopted in all improved manufactures where the warping is a separate business, and is usually done at the mill where the yarn is spun.

The warping-mill is a large reel of a cylindrical form, or rather of a prismatic form, being made with twelve, eighteen, or more sides. The reel is usually about six feet diameter and seven feet high: it is turned round on a vertical axis by a band, passing from a grooved wheel which is turned by a winch, and is placed beneath the seat on which the warper sits. (See a figure of the warping-machine for silk Plate Silk, fig. 6.) The bobbins which contain the yarn are placed on a vertical rack suspended from the ceiling, and the threads from them are all collected together and passed between two small upright rollers in a clve, which is wound up by the reel when it is turned round. To guide the clve and distribute it equally on the length of the reel, the above rollers are fixed on a piece of wood, which slides perpendicularly on an upright bar fixed at one side of the reel. The sliding-piece is suspended by a small cord, wound round a part of the perpendicular axis that rises above the reel. The cord passes over a pulley at the top of the upright bar, and goes down to the sliding-piece which carries the two rollers. When the reel turns round, the guide-rollers are slowly drawn
WEAVING.

...drawn up by the coiling of this cord round the axis; and the yarn is wound in a regular spiral about the reel, until the length which the warp requires is wound upon it. When the full length of the yarn is wound on the reel, the clue of thread is crossed over pins projecting from the frame of the reel, and the mill is then turned the reverse way, so that the slider and guide-rollers descend, and the yarn is laid downwards along the same spiral which it before ascended, so as to double the clue of thread; and this doubling is repeated until the required number of threads is collected together in one clue upon the reel.

When the warp is thus completed, it is taken off the reel and wound upon a stick into a ball; the croffings which distinguish the different returns or doublings of the simple clue being first properly secured, as a means of dividing the warp into as many equal portions as is necessary for the convenience of the weaver, in counting the threads in the succeeding operation of beaming.

There is likewise another kind of division of the threads of the warp; this is called the leafe, and serves to separate all the threads which are to go through one of the heddles of the loom, from those which are to go through the other heddle. To effect this separation, the bobbins from which the threads are drawn are arranged in two rows, and a thread is alternately drawn from the upper row and from the lower row. Then at the beginning and end of every doubling of the warp, the threads of one row of bobbins are crossed over the threads of the other row, and two pins are put into the croffings to retain them. These pins are put into holes made in pieces of board fixed to the warping-reel. One of these boards at the top of the reel is fixed fast, but the other is moveable, and can be fixed at any part of the reel, according to the length of the warp.

In the most improved warping-machines, the separation is made by an apparatus called in Scotland the hek. It consists of a row of steel pins with eyes through one end of each for the threads to pass through like large needles. These are stuck into two pieces of wood, by which they are supported in a row near to the warping-reel. Every alternate pin in the row is fastened in one piece of wood, and the intermediate pins are fastened in the other piece, so that by lifting up one piece of wood the pins and threads belonging to it will be raised up, whilst the intermediate pins and threads are held down. This occasions the division of the threads, and a pin is put in to keep them so divided. The other piece of wood is then lifted up, which occasions all the threads to be crossed; that is, every thread forms a cross over that which is adjacent to it. A second pin is then put in, and before the warp is taken off from the reel, this crossing is secured by a string.

Beaming.—When the weaver receives his warp in a large ball or bundle, he proceeds to roll it up regularly upon the yarn-roller of his loom: this is called beaming. For this purpose he employs an instrument called a separator, or ravel, which consists of a number of threads of cane, fastened together, and fixed to a rail of wood, like the teeth of a long comb; the threads are intended to be put into the spaces between these teeth, so as to stretch the warp to its proper breadth.

Ravels are somewhat like reeds, but much coarser, and are also of different dimensions. One proper for the purpose being found, one of the small divisions of the warp is placed in every interval between two of the teeth. The upper part of the ravel, called the cape, is then put on, to secure the threads from getting out between the teeth, and the operation of winding the warp upon the beam commences. In broad works, two persons are employed to hold the ravel, which serves to guide the threads of the warp, and to spread them regularly upon the beam; one or two other persons keep the threads at a proper degree of tension, and one more turns the beam upon its centre.

The knottings which secure the croffings or doublings made in warping, are very useful to the weaver in beaming, to ascertain the number of threads, and to distribute them with regularity. He cuts the knotting before he can put the warp in the ravel, but he still keeps them distinct by a small cord.

The French weavers use a small reel, upon which they wind the warp from the ball, and then from this reel they draw off the warp through the ravel, by winding up the beam. The reel is loaded with a weight, to make a regular friction, and draw the warp with a regular tension.

Drawing.—The warp being regularly wound upon the beam, the weaver must pass every yarn through its appropriate eye or loop in the heddles: this operation is called drawing. Two rods are first inserted into the leafy formed by the pins in the warping-mill, and the ends of these rods are tied together; the twine by which the thread was secured is then cut away, and the warp stretched to its proper breadth. The yarn-beam is furnished by cords behind the heddles, somewhat higher, so that the warp hangs down perpendicularly. The weaver places himself in front of the heddles, and opens the eye of each heddle in succession; and it is the business of another person, placed behind, to select every thread in its order, and deliver it to be drawn through the open eyes of the heddles. The succession in which the threads are to be delivered is easily ascertained by the leaf-web, as every thread crosses that next to it. The warp, after passing through the heddles, is drawn through the reed by an instrument called a sley, or reed-book, and two threads are taken through every interval in the reed.

The leaf-web being passed through the intervals which form the leaf, every thread will be found to pass over the first rod, and under the second; the next thread passes under the first, and over the second, and so on alternately. By this contrivance every thread is kept distinct from that on either side of it, and if broken, its true situation in the warp may be easily and quickly found. This is of such importance, that too much care cannot be taken to preserve the accuracy of the leaf. There is likewise a third rod, which divides the warp into what is usually called anvil, for two threads alternately pass over and under it; and these two threads also pass through the same interval between the even rows of the reed.

These operations being finished, the cords or mounting which move the heddles are applied; the reed is placed in the lay, or batten, and the warp is knotted together into small portions, which are tied to a threst, and connected by cords to the cloth-beam, and the yarns are stretched ready to begin the weaving.

Manner of Weaving.—The operations of weaving are simple, and soon learned, but require much practice to perform them with dexterity.

In pressing down the treadles of a loom, most beginners are apt to apply the weight or force of the foot much too suddenly. The bad consequences of this are particularly felt in weaving fine or weak cotton-yarn; for the body of the warp must sustain a great nearly equal to the force with which the weaver’s foot is applied to the treadle. The art of spinning has not yet been brought to such perfection as to make every thread capable of bearing its fair proportion of this stress. Besides this, every individual thread is subjected to all the friction occasioned by the heddles and splints of the reed, between which the threads pass, and with which
WEAVING.

which they are generally in contrast when rising and sinking. A sudden pressure of the foot on the treadle must cause a proportional increase of the irebes upon the warp, and also of the friction. As it is impossible to make every thread equally strong and equally tight, those which are the weakest, or the tightest, must bear much more than their equal proportion of the irebes, and are broken very frequently. Even with the greatest attention, more time is lost in tying and replacing them, than would have been sufficient for weaving a very considerable quantity into cloth.

If the weaver, from inattention, continues the operation after one or more warp-threads are broken, the consequence is still worse. The broken thread cannot retain its parallel situation to the reed, but crossing over or between those nearest to it, either breaks them also, or interrupts the passage of the shuttle; it frequently does both.

In every kind of weaving, and especially in thin wiry fabrics, much of the beauty of the cloths depends upon the weft being well stretched. If the motion given to the shuttle be too rapid, it is very apt to recoil, and thus to slacken the thread. It has also a greater tendency, either to break the wool altogether, or to unwind it from the pirn or bobbin of the shuttle in doubles, which, if not picked out, would destroy the regularity of the fabric. The weft of muslins and thin cotton goods is generally woven into the cloth in a wet state.

This tends to lay the ends of the fibres of cotton smooth and parallel, and its effect is similar to that of drefling of the warp.

The person who winds the weft upon the pirn ought to be very careful that it be well formed, so as to unwind freely. The best shape for those used in the fly-shuttle is that of a cone; and the thread ought to traverse freely round the cone, in the form of a spiral, or screw, during the operation of winding.

The fame wheel which is used for winding the warp upon the bobbins preparatory to warping, is also fit for winding the weft on the pirn. It only requires a spindle of a different shape, with a screw at one end, upon which the pirn, or bobbin of the shuttle, can be fixed. The wheel is so constructed, that the spindles may be easily shifted, to adapt it for either purpose.

The reeds are formed of a number of short pieces of reed or cane, or of brafs wire, fastened parallel to each other between two ficks, and cemented with pitch. This frame is enclosed between two pieces of the frame of the lay, one of which is made wide, to form the shuttle-race; the other piece, which is the lay-cap, extends across the frame, but is fitted so that it can be easily removed to take away the reeds, and substitute a finer or coarser fort, as the nature of the goods to be woven require. The manufacture of reeds, both of cane and of flax, is a separate trade. These are fully described in Les Arts et Meters, vols. 9 and 15.

To render the fabric of the cloth uniform in thicknes, the lay or batten must be brought forward with the fame force every time.

In weaving some kinds of soft or light goods, the reed is not fixed fast to the lay-cap, but is held in its place by a long thin piece of wood, which is elastic, and yields or springs when the weft is beaten up. In some cases the reed is fastened with a double woolen cord, stretched across the lay, just beneath the lay-cap, and twisted; this bears the reed, and is very elastic, but can be rendered more stiff by twisting the two cords together.

In the common operation of weaving, a regular force of the shuttle for beating up the weft must be acquired by practice. It is, however, of consequence to the weaver to mount or prepare his loom in such a manner, that the range or swing of the lay may be in proportion to the thicknes of his cloth. As the lay swings backwards and forwards, upon centres placed above, its motion is similar to that of a pendulum. Now the greater the arc, or range through which the lay passes, the greater will be its effect in driving home the weft strongly, and the thicker the fabric of cloth will be, as far as that depends upon the Elofements of the weft. For this reason, in weaving coarse and heavy goods, the heddles ought to be hung at a greater distance from the place where the weft is struck up, and consequently where the cloth begins to be formed, than would be proper in light work. The line of the lift wrought font of weft is called by the weavers the fell. The pivots upon which the lay vibrates, in general, to be so fixed that the reed will be exactly in the middle, between the fell and the heddles, when the lay hangs perpendicularly. As the fell is constantly varying in its situation during the operation, it will be proper to take its medium; that is, the place where the fell will be when half as much is woven as can be done without taking it up on the cloth-roll, and drawing fresh yarn from the yarn-roll.

The periods for taking up the cloth ought always to be short in weaving light goods; for the less that the extremes of the fell vary from the medium, the more regular will be the arc or swing of the lay. Mr. James Hall had a patent, in 1803, for a method of perpetually winding up the cloth-beam, so as to take away the cloth as fast as it was woven, or shoot by shoot. This was effected in a simple manner by a ratchet-wheel fixed on the end of the clothbeam, and a proper catch to move it round one tooth at a time; the catch was actuated by the motion of the lay. A similar method is used in ribbon-weaving.

The variations in the structure of looms from that which we have described, are not material. The framing is varied in almost every different kind of loom, and ought always to be suitable in strength to the kind of cloth which is to be woven. The loom used for silk is very light in all its parts; but for carpet and fail-cloth it must be very strong.

In looms for heavy goods, the cloth-beam is not placed at the breast of the weaver, as it is too large that it would impede his working; the cloth is therefore passed over a fixed bar in the place of the cloth-beam represented, and the beam is placed lower down, and near the weaver's feet, out of the way of his knees. The heddles are connected by levers, in some looms, instead of pulleys; but the effect is always the same; viz. to make one heddle ascend when the other descends. For weaving fine goods, the heddles would be inconveniently close together, if all the yarns went through two heddles; hence they use four heddles instead of two; but their action is just the same, because they are connected together in pairs, and when one pair rises the other pair sinks. Many looms are still made without the fly-shuttle; and in that case the shuttle is merely thrown from one hand to the other, and then thrown back again: this obliges the weaver to change his hands continually, and the operation is more complicated. For wide cloths, which are more than a man can reach across, two persons were always employed before the fly-shuttle was introduced, which is only within a few years; but by its assistance one person can weave the greatest breadth. The fly-shuttle is the best for all kinds of work, and its construction is so simple that no other ought to be used.

Treatment of different Kinds of Yarn.—The manner of weaving all kinds of plain cloth is much the same, whether it is wool, silk, flax, or cotton; except that the two latter require
WEAVING.

require what is called dressing. Silk and woollen warps require little preparation after being put into the loom, except to clear the yarn occasionally with a comb, to remove knots or lumps which might catch in passing through the reed; the comb detects such lumps, and they are removed with the affixture of a pair of scissors. Flax and cotton, but particularly the latter, require the warp to be dressed with some glutinous matter, to cement the fibres, and lay them close. This is applied in a fluid state, and as the weaving does not proceed well after it is suffered to dry, the warp is dressed with a brush when in the loom, a small quantity at a time, immediately before it is woven.

Dressing.—The use of dressing is to give to yarn sufficient strength or tenacity, to enable it to bear the operation of weaving into cloth. By laying smooth all the ends of the fibres of the raw materials, from which the yarn is spun, it tends both to diminish the friction during the process, and to render the cloth smooth and glossy when finished. The dressing in common use is simply a maculation of vegetable matter boiled to a constituency in water. Wheat-flour, boiled to a paste like that used by book-binders, or sometimes potatoes, are commonly employed. These answer sufficiently well in giving to the yarn both the smoothness and tenacity required; but the greatest objection to them is, that they are easily affected by the action of the atmosphere. When dressed yarn is allowed to stand exposed to the air for any considerable time, before being woven into cloth, it becomes hard, brittle, and comparatively inflexible. It is then tedious and troublesome to weave, and the cloth is rough, wiry, and unweven. This is chiefly remarked in dry weather, when the weavers of fine cloth find it necessary to work up their yarn as speedily as possible, after it is dressed. To counteract this inconvenience, herring or beef brine, and other saline substances which attract moisture, are sometimes mixed in small quantities with the dressing; but this has not been completely and generally successful; probably, because the proportions have not been sufficiently attended to; for a superabundance of moisture is equally prejudicial with a deficiency. The variations of the moisture of the air are so great and frequent, that it is impossible to fix any universal rule for the quantity of salt to be mixed. Some weavers put butter-milk in the paste.

To apply the dressing, the weaver must suspend the operation of weaving, whenever he has worked up that quantity of warp which he has dressed, or within two or three inches; he then quits his seat, and applies the comb to clear away knots and burs; next pushes back the leafe-rods towards the yarn-roll, one at a time, and if they glide freely between the yarns, it shews they are clear from knots; he then brushes the yarn with the paste by two brushes, holding one in each hand. The superfuous humidity is afterwards dried by fanning the yarns with a large fan, and then a small quantity of grease is brushed over the yarn; the leafe-rods are returned to their proper position, and the weaving is resumed.

Dressing is of the first importance in weaving warps spun from flax or cotton; for it is impossible to produce work of a good quality, unless care be used in dressing the warp.

The same practice, when used upon silk, has a very destructive tendency: it injures the colours of the silk when used, as it is sometimes very improperly, by the weavers of white satin. The injury done to the work is irreparable. In cotton, the operation of dressing is indispensible; but in silk, this is by no means the case.

The preparation of paste orsize for warp, has been the object of several patents. Mr. Foden, in 1799, recommends a quantity of calcined gypsum, or plaster of Paris, to be reduced to a very fine powder, and then mixed with alum, sugar, and the farina or flour of potatoes, or any other vegetable farina. This powder, when mixed well with cold water, forms a soft paste, to which boiling water is to be added, and the mixture thoroughly stirred till it becomes sufficiently gelatinous for use.

Another size, for which Mr. Wilks held a patent in 1801, is prepared as follows:—The size or flour is to be extracted from any kind of potatoes which are mealy when boiled, by grating them while raw (but washed clean) into a tub of water. The water, thus impregnated with the grated potatoes, is run through a sieve or strainer, which will retain the coarser and fibrous parts of the potatoes, but admit the finer particles, conflagrating the size or flour, to pass with the water into a vessel beneath the sieve or strainer. This water must remain in the vessel several hours undisturbed, to permit the size to subside to the bottom; then the water is poured off, and the size so obtained is put into fresh water, and passed through a finer sieve into another tub, where the size is left to subside to the bottom as before, and the water is again poured off.

About two-thirds the quantity of potatoes, which furnished the size, are also to be boiled without peeling, to as to make them mealy when boiled; they are then mashed, and diluted with water, so that they will pass through a sieve into a boiler. In this the mashed potatoes are heated till they almost boil; and the size from the grated potatoes is then to be added, and the whole boiled and stirred for 20 minutes, when it will become paste proper for use. It should be spread in a flat open vessel to cool.

Improved System of Weaving by Machinery.—In our article Cotton we mentioned that weaving-looms, worked by mechanical power, were then coming into use: since the time that article was printed these have made great advances; but to use them with advantage, the preparatory processes of warping and dressing must be conducted in a particular manner. Many attempts have been made to diminish the number of operations through which the yarn must pass by combining several together. Mr. Stuart had a patent in 1800 for fixing or starching cotton-yarn whilst in the cop, so that it would be ready to warp at once. Mr. Maryland had a patent in 1805 for the same object; his plan was to expel the cops of cotton to the action of the hot size in an exhausted receiver; the pressure of the atmosphere being thus removed, the size penetrated readily to the centre. It was found difficult to dry the cop perfectly, and the threads were sometimes fastened together as to render the winding off difficult.

Another plan has therefore been introduced both for flax and cotton: this is to wind off the yarn from the cop or bobbin in which it is spun, and gather it upon the bobbins ready for the warping; by this manner the reeling is saved. A small quantity of strong is applied to the yarn during the operation, by causing it to pass over a horizontal wooden cylinder, which revolves on its axis in a trough filled with fluid starch. The threads, in passing from the cop to the bobbin, are drawn over the upper surface of the cylinder, and receive the size with which it is covered. The winding machine for this acquired a great number of bobbins at once; the warping is then conducted, as we have before described, and the dressing is performed in the loom whilst weaving, that is, when woven by hand; but for the power-loom it is dressed previously to placing it in the loom.

Dressing Machines.—Mr. Johnson, of Stockport, had a patent, in 1804, for a method of dressing whole webs of warp at once,
one, by a machine. The yarns were wound off from the bobbins or cops of the spinning machines upon beams or rollers. Several of these rollers were placed parallel to each other, in an horizontal direction, at the opposite ends of the machine, from three to six at each end; and the yarns from them were all combined together in one web, which was received and rolled up on the yarn-beam of the loom placed in the middle of the machine, and raised up considerably above the other rollers, so that the yarns proceeded from both ends of the machine towards the middle. In their passage they passed through several reeds to keep them separate, and were supplied with the pats by passing over two cylinders revolving in a trough of fluid pate. This pate was dressed or worked into the yarn by means of two brushes, of a length equal to the breadth of the web; one of the brushes acted upon the upper side of the yarns, and the other on the lower side. A similar pair of brushes were applied at both ends; each brush had a motion given to it by means of cranks, exactly similar to the movement with which the weaver brushes the yarn in the loom. Near the yarn-roller a fan was placed, like that used in a winnowing machine, which blew a current of air through the yarns of the warp to dry them before they were rolled up by the beam. To preserve the leaf, the yarns were conducted through a pair of heddles, similar to those of the loom, but they remained slack to avoid friction.

The machine was moved by the mill with a constant and regular movement.

When a warp is thus warped, beam'd, and dressed, the yarn-beam is carried to a loom, on which the yarn is now produced, and is made to replace the empty yarn-roll. The ends of the yarn are joined to the old yarns by twining, and are thus drawn through the heddles and reed, so that the weaving can be resumed with very little loss of time, and the weaver can proceed with his work without any interruption for dressing. The principal objection to the above machine is the friction which the yarns must undergo in the process of dressing, and in passing through so many reeds; it was, however, practiced in a large work at Stockport; but the weaving was performed by hand.

Another dressing machine was invented by Mr. M'Adam, and he obtained a patent in 1806; it is practiced by Mr. Monteith, at Pollockshaws near Glasgow. This machine is very much like the former in its manner of action. Instead of using three, four, or six beams at each end of the machine, there are only two beams, each containing one-half the number of yarns for the intended warp. The fitch is supplied in the same manner as the former, or sometimes by making the two yarn-beams themselves turn in a trough of flitch without employing a separate cylinder. The brushing is performed in a more simple and effectual manner by using cylindrical brushes, which revolve with a regular motion, two of them are applied on the upper side of the warp, and two on the lower side; also four fammers are applied to dry the warp instead of one. The yarns were conducted between reeds and through heddles, like the first machine; and hence the same objection of friction applies to both.

Mr. Duncan, in his Essays on Weaving, describes another method of dressing warps, which is practiced by Mr. Dunlop at Barrowfield. In this the yarn is warped and beam'd in the usual manner, upon a yarn-roll; from this the yarn is unwound, and takes up upon another beam; and in its passage from one to the other it is extended, so that the picking and clearing can be performed in the usual way by hand, with a comb and scissors, and the dressing is applied with brushes in the usual way; beneath the warp a fan is placed, to blow a current of air up through the yarns and dry them. In this machine all the operations, except the frosting, are performed by hand; the advantage, therefore, consists only in the division of labour, by making the dressing and weaving distinct operations.

**Power-Looms.**—In the article Cotton we have mentioned Mr. Dolignon's claim to the invention of weaving by mechanical power.

The original project, we believe, was by M. De Gennes, and is published in the Philosophical Transactions for 1785, No. 145. See also Lowthorp's Abridgement, vol. 1, p. 498. This is a very ingenious invention. The fly-shuttle was not then invented, and he supplied the want of it by a contrivance which held the shuttle as it were in a hand by fingers; this carried it half way through the cloth, and then it was transferred to another similar hand, which drew it through the remainder. By this means there was a greater certainty than in throwing the shuttle from one side to the other, because the shuttle always continued engaged with the mechanism: the whole machine is ingenious and-worthy of notice.

M. Vaucanson, the celebrated French mechanist, made a machine for weaving ten ribbons at a time, which was worked by a circular motion given by the workman; and it might, therefore, have been worked by mechanical power. This is described in the Encyclopaedia Methodica in great detail, with ten folding plates, and is an ingenious machine.

We believe both these inventions were prior to that of Mr. Dolignon; and also that the merit of inventing the machine, and first reducing it to practice, is due to Mr. Audlin, of Glasgow. In this gentleman's memoir to the Society of Arts, he states, that his first attempt was made in the year 1790, when he entered a caveat for a patent, but did not apply for it further; since that time he made many improvements upon the original plan. In 1796 a report in its favour was made by the Chamber of Commerce and Manufactures at Glasgow; and in 1798, a loom was set up at work by Mr. J. Monteith's spining works, at Pollockshaws near Glasgow, which answered the purpose so well, that a building was erected by Mr. Monteith for containing thirty looms, and afterwards another to hold about two hundred.

**Mr. Audlin's Power-Loom.**—The model from which our drawing (Plate I. Weaving) was made, is deposited in the Society of Arts; it is an improvement upon the looms constructed for Mr. Monteith.

The drawing Plate I. is a perspective view, exhibiting the whole loom at a glance; it is viewed from the back rather than from the front.

A is a square iron axis extending through the whole length of the machine; to this the power of the first mover is applied by a cog-wheel B, of thirty-six teeth, turned by a pinion of twelve leaves fixed to the axis of the fly-wheel D. A handle is fixed to one of the arms of the wheel to give motion to the model; but in the large machine a live and dead pulley are adapted to the axis of the flyer-wheel; and by means of an endless strip, the power is communicated from any convenient part of the mill in which a great number of looms are placed together.

The axis A has several eccentric wheels or camms fixed upon it; these revolve they give motion to a number of levers or treadles, by which all the usual operations of the loom are performed at the proper intervals: these are,

1. First, To separate the two parts of the yarns of the warp, as shown at G, and admit of the passing of the shuttle.

2. Secondly, To throw the shuttle, in order to lay the weft or cross-threads of the cloth.

3. Thirdly, To move the lay 7.8, and return it; so that the reed g will beat up the weft clothe to the fell, or preceding
WEAVING.

ceeding foot of the weft: this renders the cloth of uniform

texture.

Fourthly, To wind up the cloth upon the cloth-roll, as

done as it is formed by the preceding operations.

The yarns, which are to form the warp of the cloth, are

warped in the manner before described upon the yarn-roll

F; and from thence they are extended horizontally to the

cloth-roll E, of which only a small part can be seen at the

opposite side of the loom: in their way the yarns pass

through the eyes of the heddles G H, which effect the first

operation above-mentioned. Each heddle is composed of a

number of perpendicular threads equal to half the number

of yarns in the warp; these are stretched between two

small rods a a and b b, and in the middle of each thread is a

small eye, through which a yarn of the warp is passed;

thus, the first yarn of the warp is passed through the eye

of the heddle G, but has no connection with the heddle H,

because it passes between its threads. The second yarn is

put through the eye of the heddle H, but has no con-

nection with G; the third yarn is attached to H; the

fourth to G, and so on alternately throughout the whole

number. By this means if one heddle is raised up, and

the other at the same time depressed, a separation of the

yarns will take place as shown at G, every other yarn

being raised up, whilst the intermediate ones are drawn
down, so as to admit the passage of the shuttle and wcf

between them.

The two heddles are moved by camms upon the main

axis A; and they are so connected by short levers I I, which

are suspended from the upper part of the loom, that when

one heddle is pulled down, the other will be drawn up at the same time, because they are suspended from the

opposite ends of the levers I.

The camms on the main axis for the heddles are marked

L; the two are exactly similar, but are reverved upon the

axis; that is, the shortet radius of one is placed on the same

side with the longest of the other. They act upon two

levers, which are the same as the treadles in a common loom;

only one of these treadles or levers (viz. that which belongs

to the camm L) can be seen at M, the other lever being

concealed from the view; both levers move on centres at

between the small uprights d d ; the other ends slide freely

up and down between similar uprights at the opposite side of

the frame, which cannot be seen in the figure; the levers

are connected with the heddles, which being suspended from

the levers I as before mentioned, the levers will therefore move in contrary directions, the one rising when

the other is pressed down by the action of the camm on the

axis A.

The connection between the levers or treadles M and

the heddles G H, is made by cords communicating with

two counter-levers O P, which are centered in uprights

supported by the frame at the ends of the machine. The

counter-levers O P are connected with rods b and k, and

these by a double cord are attached to the heddle-rods a a

and b b. This machinery which we have now described effects the

separation of the warp thus: when the axis A turns round,
every revolution of its cammm L will cause two separations of

the warp, and each one in a different manner, for those yarns

which are raised up at one time are drawn down the next.

The second operation, viz. throwing the shuttle, is per-

formed by two camms R S, which are reversed to each other

upon the axis A. They act upon two levers, only

one of which can be seen at T; they are placed beneath the

camms. The shuttle requires to be projected with a

sudden jerk; these levers are therefore centered at d on the

fame pin as the levers M and N, but the other ends preb

down smaller levers W, which are centered at the opposite

end of the frame, and lie beneath the long levers. The ex-

treme ends of these smaller levers are connected by a strap f

with a segment of a wheel, which has a long item of whalebone

Y fastened to it; and by means of two strings, one of which

is shown at g a it moves the reeds or drivers z upon the

wires 3 3, and throws the shuttle. The shuttle, which is

thrown in a separate figure, is pointed at each end, and

wound with iron; it contains two small rollers 3 31 upon which it

runs; and as they project through both surfaces, it will run

either way upwards, or either end first. In the centre of the

shuttle is an oblong mortise, containing the pin or bobbin

33, on which the thread for the weft of the cloth is wound;

and the end of the weft marked 3 3, is brought through a

small glass tube, called the eye of the shuttle.

The action of the mechanism for throwing the shuttle

is as follows:—By the revolution of the camm R, the long

levers beneath it are depressed, and at the same time the ex-

tremity of the shorter lever W descends, but with an increased velocity; this by means of the strap f turns the

segment of a wheel on its centre, and its tail Y flatches the

string g of the pecker e, and makes it strike against the shuttle

with such a velocity, as to drive the shuttle out of the

trough Q across the shuttle-race, into the opposite trough,

where it will push back the pecker, and remain at rest in the

trough ready for the next stroke: by this stroke it will be

returned back again with an action similar to the last, but

occasioned by the other cammm S, and its corresponding

levers.

The threads of the warp, which are lowest when the

separation takes place, are drawn down by their heddle

G or H, so as to lie close upon the shuttle-race, and cause

no obstruction to the passage of the shuttle. To facilitate

this, the shuttle must be very smooth on the surface, that it

may not catch the threads and be flopped. The shuttle-

race is inclined towards the reed, both that the yarn may

lie flat upon it, and that the shuttle may not be liable to

run off its race; for as it leaves the weft, which is drawn off from its bobbin, in the space between the divided yarns

of the warp, it might be drawn off its race sideways, without

this precaution. In this manner the second operation is

performed.

The third motion is that of the reed g: this is fixed close

debre the shuttle-race, and is a frame containing a great

number of parallel slips of reed or cane; between these

the yarns of the warp pass, and when the whole frame of reeds

is moved towards the cloth-roll E, they will act in the man-

ner of a comb, to beat up the thread of the weft, which is

left by the shuttle lying loosely between the yarns of the

warp.

For this purpose, the shuttle-race, reeds, peckers, &c. and

their item Y, with its segment of a wheel, are all placed on a

frame which moves on hinges at the lower ends, 8, of the

two upright slits 8. This frame, which is termed the lay,

is drawn backwards by means of straps 10, 10, rolled upon

pulleys 11, fastened upon the axis 12; upon this frame axis

are two other smaller pulleys, upon which two straps, 13,

are rolled, to connect with the long levers 14, which are

moved by the camms 15, upon the axis A.

The long levers, 14, are centered at one end of the frame,

and the pulleys on the axis, 12, being of different diameters,

the motion of the reeds will be performed very quickly.

To move the lay in a contrary direction, and give the stroke

to beat up the weft, two large weights, like m, are suspended by straps from pulleys on an horizontal axis, which carries

two larger wheels x; on these, straps are wound, to commu-
nicate with the upright sides, 7, 8, of the lay, and draw it forwards.

When the loom is acting very quickly, these weights would not act with sufficient sharpness to throw the reeds against the threads of the weft with the proper force.

The weights are therefore connected by spiral wire-springs, with long levers 16, which are pressed down by a cam or rather tappet 17, fixed on the main axis. These levers act before the lay is at liberty to move; and by pressing down the levers extend the springs; consequently, as soon as the cam 15 pulls the lever 14 to rise, the springs act instantaneously, to throw the lay and the reeds forwards to beat up the weft.

The infant after the blow has been given, the lay is drawn back again by the cam 15, and returned into the vertical position, in which situation the lay must continue whilst the shuttle is thrown; for this purpose, the outsides of the camms 15 are portions of circles. This completes the third motion.

As full as the cloth is fabricated by the foregoing movements, it is gathered upon the cloth-roll E. This is turned slowly round by a small crank 19, on the extreme end of the main axis A; the crank moves a small rod 20 up and down, in order to turn a small ratchet-wheel round one tooth each revolution of the main axis; the return of the ratchet is prevented by a click. On the axis 21 of the ratchet-wheel is an endless screw, to engage the teeth of a cog-wheel upon the end of the cloth-roll, and give it a slow motion.

The yarn is kept to a proper degree of tension by the friction occasioned by a line 28 passed twice round the yarn-roll, one end being fastened to the frame, and the other to a lever 30, loaded with a weight.

The framing of the loom is too evident to need description. In the construction of the machine, the principal circumstance to be attended to, is the figure of the different camms; also that they are placed upon the axis A in the proper situations relative to each other. These cautions will ensure the accurate performance of the machine.

The camm R or S, for throwing the shuttle, is formed with a hidden beak or projection, that it may strike the lever T down instantaneously, and throw the shuttle; from this beak the curve continues circular for some distance, that the lever may be held stationary; the remainder of the camm gradually diminishes its radius like a spiral, and quits the lever, in order to leave it at liberty to rise up when its corresponding lever is forced down by the beak of the other similar camm S.

The camm L, for the heddles is made circular where it is to come in contact with the lever, and which is all the time it is in action. This occasions the levers and heddles to be stationary whilst the shuttle is thrown.

The inventor states that, by the addition of some simple improvements, his looms have the following advantages: viz. 300 or 400 of them may be worked by one water-wheel, or steam-engine, all of which will weave cloth in a superior manner to what can be done in the common way. They will go at the rate of 60 floats in a minute, making two yards height of what is called a nine hundred web in an hour. They will keep regular time in working, stop and begin again, as quick as a stop-watch. They will keep constantly going, except at the time of shifting two shuttles, when the weft on the pins is exhausted. In general, no knots need be tied, and never more than one in place of two, which are requisite in the common way when a thread breaks. In case the shuttle floats in the shed, the lay will not come forwards, and the loom will instantly stop work-
ing. They will weave proportionally slower or quicker, according to the breadth and quality of the web, which may be of the breadth now made. They may be mounted with a harness or spot-heddles, to weave any pattern, twilled, striped, &c.

There is but one close shed, the same in both breadths, and the strain of the working has no effect on the yarn behind the rods.

The fell and temples always keep the same proper distance. There is no time lost in looming, or cutting out the cloth; but it is done while the loom is working, after the first time.

The weft is well stretched, and exactly even to the fabric required.

Every piece of cloth is measured to a straw’s breadth, and marked where to be cut at any given length.

The loom will work backwards in cafe of any accident; or of one or more floats missing. Every thread is as regular on the yarn-beam as in the cloth, having no more than two threads in the runner. If a thread should appear too coarse or fine in the web, it can be changed, or any stripe altered at pleasure. They will weave the finest yarn more tenderly and regularly than any weaver can do with his hands and feet.

When a thread, either of warp or weft, breaks in it, the loom will instantly stop, without flopping any other loom, and will give warning by the ringing of a bell. A loom of this kind occupies only the same space as a common loom; the expense of it will be about half more; but this additional expense is more than compensated by the various additional machinery employed for preparing the yarn for the common loom, and which this loom renders entirely unnecessary.

The preparatory processes of reeling, winding, warping, beaming, and looming, and the interruptions occasioned by combing, dressing, fanning, greasing, drawing bores, shifting heddles, rods, and temples, which is nearly one-half of the weaver’s work, do not happen in these looms. The general waffe accompanying the above operations is stated at about 15 per cent. of the value of the yarn, all which occur in the operations of the common loom. The power-loom, without further trouble, performs every operation after the spinning, till the making of the cloth is accomplished, by which a saving is effected of about 20 per cent. of the yarn.

The heddles, reed, and brushes, will wear longer than usual, from the regularity of their motion. More than one-half of workmanship will be saved; one weaver and a boy being quite sufficient to manage five looms of coarse work, and three or four in fine work.

Mr. Miller’s Power-Loom.—A patent was taken out for this in 1796. It is so much like Mr. Aultlin’s in its general principle, that it is unnecessary to enter into the description. The motions are all produced by camms fixed on a horizontal axis, and operate upon a number of horizontal levers, disposed beneath the loom, in the situation of treadles; in other respects the arrangement of the parts is very different. This is sometimes called the wiper-loom, wiper being a different name for a camm.

Crank Loom by Power.—In this the treadles are actuated by cranks, instead of camms or wipers. The reciprocating motion produced by a crank is not uniform, but accelerated at one time, and retarded at another. This is an advantage in some of the operations of a loom. It is true, that, by means of wipers, any required law of acceleration may be produced; but in a crank, the acceleration must proceed according to one law. The superiority of cranks arises from
WEAVING.

from the circumstance, that they will communicate motion in both directions; whereas a cam will only pull a lever in one direction, and the return of the motion must be made by a spring or counterweight. Now, if this counterweight is too large, it makes unnecessary loss of power and friction; and if it is too small, there is some uncertainty in the return of the lever.

Mr. Todd of Boulton had a patent, in 1803, for improvements in power-looms.

Mr. Horrocks of Stockport had three successive patents for this kind of machinery, in 1803, 1805, and 1813. The machine described in the latter is a crank-loom; that is, the lay is actuated by a crank to beat up the weft. The principal improvement consists in a system of levers, which transmit the action of this crank to the lay, and so modify it, that the lay will advance quickly, and give an effective stroke to the weft, and then withdraw quickly to a stationary position, in which it will remain whilst the shuttle is thrown. The advantages which are stated are, that a large shuttle may be used, sufficient to hold a full-sized cop of weft: the waste and loss of time by renewing the cop will, therefore, be less. From the shafts, shuttle-boxes, and levers will be required on the yarn-beam, and this will occasion the heddles to work more lightly, so as to break fewer threads. From the same cause, more threads of the weft may be laid in an inch, and make closer work.

Mr. John of Preston had a patent in 1805, and another in 1807, for a power-loom, in which the warp is stretched on a vertical plane, instead of horizontal, as in former machines. The advantages of this are stated to be, 1st, that it takes less space; 2d, the reed serves for the shuttle-race, because the shuttle runs upon the reed itself, and, therefore, makes no friction upon the yarns; 3d, also in dressing, picking, and clearing the warp, the attendant always remains in front of the machine, and can continue to watch the machine; whereas, in the other looms, he must quit his post in front, and go round behind the looms for these operations. When the dressing is to be applied to the warp, whilst it is in the loom, that part of the warp is conducted horizontally for that purpose, and a fan is applied to dry the warp.

The latest inventions of power-looms are Mr. Peter Ewart's patent, 1813; and Mr. Duncan's loom, which he calls a vibrating loom.

The Indian Loom.—This is a striking contrast to our power-looms; it consists merely of two bamboo rollers, one for the warp, and the other for the finished cloth; and a pair of heddles. The shuttle performs the double office of shuttle and reed; for this purpose, it is made like a large netting-needle, and of a length somewhat exceeding the breadth of the piece of cloth which is to be woven.

This apparatus the weaver carries to any tree which affords a shade most grateful to him: under this he digs a hole large enough to contain his legs, and the lower part of the geer or heddles; he then stretches his warp, by fastening it on a turf, by wooden pins; the balance of the geer or heddles he falls upon some convenient branch of the tree over his head; and two loops underneath the geer, in which he infers his great toes, serve instead of treads; his long shuttle, which performs also the office of a batten, draws the web, throws the warp, and afterwards strikes it up close to the web. In such looms as these are made those admirable millins, whose delicate texture the Europeans can never equal, with all their complicated machinery.

The weaving, even of their finest millins, is thus conducted in the open air, exposed to all the intense heat of their climate. We know well that this would be impracticable with fine work in this country, even in an ordinary summer day, on account of the sudden drying of the dress- ing. It is not known what is the substance which the Indian weavers employ for dressing their warps. It might be of use to our manufacturers, we were this investigated in a satisfactory manner. It is said to be a decoction of rice, formed by boiling the rice in a small quantity of water, and expressing the juice: when this is cool, it forms a thick glutinous substance, which undergoes some kind of fermentation before it is used.

Figure-weaving.—Having given an account of the nature and process of plain weaving, we must notice the fanciful and ornamental parts of the binnies. The extent to which this species of manufacture is carried renders it an object of very great national importance, and deserving a more minute description than our limits will admit.

Figures or patterns are produced in cloth, by employing threads of different colours, or of different appearance, in the warp, or in the weft. By the dressing, the threads must be laid by, that some colours will be concealed and kept at the back, whilst others are kept in the front; and they must occasionally change places, so as to fly as much of each colour, and as often as it is necessary, to make out the figure or pattern.

The weaver has three means of effecting such changes of colour: 1st, by using different coloured threads in the warp, or threads of different sizes and substances; these are arranged in the warping, and require no change in the manner of weaving. This is confined to striped patterns, the stripes being in the direction of the length of the piece.

Secondly, by employing several shuttles charged with threads of different colours or substances, and changing one for another every time a change of colour is required. This makes stripes across the breadth of the piece; or, when it is combined with a coloured warp, it makes chequered and spotted patterns of great variety.

Thirdly, by employing a variety of heddles, instead of two, as we have hitherto described: each heddle having a certain portion of the warp allotted to it, and provided with a thread. When this thread is deprived of its balance from this other that heddle will be drawn up, and the reed will be deprived; consequently, when the weft is thrown, all these yarns which are drawn up will appear on the front or top of the cloth; but in the intervals between them, the weft must appear over those threads which are deprived. The number of threads which are thus brought up may be varied as often as the weaver chooses to prefix his foot upon a different treadle, and by this he produces his pattern.

All these means may be combined together, and give the weaver the means of representing the most complicated patterns.

The principal varieties of woven cloth, including only those which require a different process for their fabrication, are the following:

1. Stripes are formed upon the cloth either by the warp or by the woof. When the former of these ways is practiced, the variation of the process is chiefly the business of the weaver; but in the latter case, it is that of the weaver, as he must continually change his shuttle.

By unravelling any sherd of striped cloth, it may easily be discovered whether the stripes have been produced by the operation of the warper or those of the weaver.

When the fly-shuttle is used, the changing of the shuttle is very readily effected by a simple contrivance. One of the shuttle-boxes or troughs, as we have before called them, (Plate)
WEAVING.

(Plate II. Weaving, fig. 2.) is made in two parts, so that a part of the trough I near the pecker, where the shuttle lies during the time it is at rest, can be removed, and another trough substituted, which contains a different shuttle. For the purpose of making the change with facility, a moveable shuttle-box \( n \) is suspended by two perpendicular lines \( o \) from a wire or centre of motion \( m \) attached to the lay, as is shown by the dotted lines. The moveable box is just on the same level with the shuttle-trough \( I \), and is divided by partitions into two or three separate troughs, each exactly the width of the regular trough, and as long as is necessary to contain a shuttle. The pecker \( k \), and the wire upon which it slides, remain exactly as before described; but by swinging the moveable box \( n \) on its centre any one of its compartments may be brought to line with the real place for the shuttle-trough in which the pecker runs. The moveable box must have proper catches to hold it exactly in its true positions.

In working with this contrivance a shuttle of a different colour must be placed in each cell or division of the moveable box \( n \); and when the weaver desires to change the shuttle he pulls the connecting string. This moves the shuttle-troughs either backwards or forwards, so as to carry away that shuttle which has been just in use, and place another before the pecker. Then if he pulls the pecker-handle, the new shuttle will be thrown across the shuttle-race, just as the old one was in the former instance. If only one moveable shuttle-box is used there will be some limitation in the pattern, because the stripes of different colour must always consist of an even number of the same coloured thread, as two, four, six, &c. This may be obviated, and a greater change of shuttles may be introduced, by using two moveable shuttle-boxes, one at each end of the shuttle-race: in that case the two moveable boxes are provided with cranks and strings, so that the weaver can reach either of them with ease.

Checks are produced by the combined operations of the warper and the weaver.

Tweedled cloths are so various in their textures, and so complicated in their formation, that it is difficult to convey an adequate idea of the mode of constructing them without the aid of several drawings.

In examining any piece of plain cloth, it will be observed that every thread of the weft crosses alternately over and then under every thread of the warp which it comes to; and the same may be said of the warp: in short, the threads of the warp and weft are thus interwoven at every point where they cross each other, and are therefore tackled alternately.

Tweedled cloth is rather different, for only the third, fourth, fifth, sixth, &c. threads cross each other, to form the texture.

Hence two, three, four, or more, of the successive threads or floats of the weft will be found to pass under or over the same thread of the warp; or, in other words, by tracing any thread of the warp it will be found to pass over two, three, four, or more threads of the weft at once, without any interweaving the warp. Then it crosses and passes between the threads of the weft, and proceeds beneath two, three, four, or more threads, before it makes another passage between the threads of the weft.

Tweedled cloths are of various descriptions, and produce different kinds of patterns; because at all the interfering points where the threads actually cross, or interweave both threads of warp and weft are feen together, and these points are therefore more marked to the eye, even if the warp and weft are of the same colour. These points in plain tweeds form parallel lines extending diagonally across the breadth of the cloth, with a different degree of obliquity, according to the number of weft threads over or under which the warp threads pass before an interfacement takes place. In the coarsest kinds every third thread is croffed; in finer fabrics they cross each other at intervals of four, five, six, seven, or eight threads; and in some very fine tweedled filks the croffing does not take place until the sixteenth interval.

Tweeling is produced by multiplying and varying the number of heddles, or, as the weavers express it, the number of leaves in the harnesses, which is the name given to the whole number of heddles employed in a loom; by the use of a back-harness or double-harness, by increasing the number of threads which pass through each split of the reed, and by an endless variety of modes in drawing the yarns through the heddles; also by increasing the number of threads, and changing the manner of threading them.

The number of threads requisite to raise all the heddles which must be used to produce very extensive patterns, would be more than one man could manage; for if he placed his foot by mistake on a wrong treadle he would disfigure his pattern. In these cases, recourse is had to a mode of mounting or preparing the loom, by the application of cords to the different heddles of the harnesses; and a second person is employed to raise the heddles in the order required, by pulling the strings attached to the respective heddles of the back-harness, and each heddle is returned to its first position by means of a leaden weight underneath. This is the most comprehensive apparatus used by weavers, for all fanciful patterns of great extent, and it is called the Draw-Loom. See that article.

The manner of mounting the harnesses of looms, to produce all the principal varieties of fabrics, is detailed in our articles Design, Draught, and Cording of Looms; also Damask, Diaper, Dimity, Dornock, Fustian, and Tapesty. A perusal of those articles will render it unnecessary for us to proceed farther on that subject in the present article. We shall however describe a most valuable invention, which has of late years come into ufe, as a substitute for the second person or draw-boy, who must be employed in the draw-loom, by which loom alone all the complicated patterns can be woven.

Machine called the Draw-Boy, because it performs the Office of a Draw-Boy in Weaving.—The saving of labour is not the only advantage of this machine; the certainty of its operation and security from mistake are obvious. The weaver produces the required action upon the most complicated harnesses by two treadles only, which he works alternately, jut with the same motion as in plain cloth-weaving. The machine, when once set up, performs every thing else.

Like most other inventions, this was at first imperfect, but has been gradually improved. We do not know its history, but we have seen great numbers of machines, for carpet-weaving and coarse goods, which have been some years in use. The machine is situated in a small square frame, not larger than a chair, which stands at the side of the loom, and cords from all the different heddles are conducted from the draw-loom down to this frame, where they are arranged in order. Each cord has a knot answering to the handle, which the boy must pull in the common draw-loom; and there is a piece of mechanism actuated by the treadles which at every stroke selects the proper cord, and draws it down so as to raise the heddles belonging to it. The next time it changes its position and takes another cord, and so on until the whole number of cords has been drawn and the pattern completed.

These original machines have a great defect, viz. that they only proceed with regularity to raise up all the heddles, until all the cords have been drawn, and one series of changes has
has been gone through; but when this is completed, and a repetition of the pattern is wanted, the weaver must stop and restore the machine to its original position by pulling a string. This appears very easy, but it diverts his attention; and if he does not do it at the exact moment his pattern may be spoiled. This defect was remedied by Mr. Alexander Duff, who received a small and inadequate premium from the Society of Arts in 1807, probably because they were not aware of its value and importance; but in 1810 we find them with a liberality truly discreet to real merit, giving an equal reward to another person, for the most trivial alteration of Duff's machine. The latter machine is alone described in their Transactions; see vol. xxviii.

Mr. Duff's Draw-Boy.—Fig. 4. Plate II. Weaving, is a plan of this machine, and fig. 2, a perspective view. It is fixed at the side of a draw-loom, in the same place as a draw-boy would stand, and H flew the cords which are to draw the harnets. The fame letters are used in both figures. A A is a square wooden axis, mounted fo as to turn backwards and forwards in the frame B B, on points or centres of motion. At one end of it a pulley D is fixed, to receive a line a a fastened to it at the highest point, by means of which the axis receives motion from the two trebles of the loom, one of the trebles being attached to one end of the line, and the other to the opposite end of it. E E are two rails of wood, fixed across the frame parallel to the axis; and e e are two brafs plates screwed to the rails, and pierced with a great number of holes to receive as many cords. Each cord is tied by one end to a central rail F of the frame beneath the axis; and after passing through one of the holes in the above plate e and turning over a round wooden rod G, has a lead weight suspended to the other end of it. These weights are shewn at b b. The rods G G are suspended by strings at their ends from the ceiling of the room. To each of the above cords another is tied just before it paffes over G. These are reprefented by H, and hang loosely. The upper ends of these cords are tied to horizontal cords extended across the ceiling of the room, and made fast to the ceiling at one end; the other ends paff over pulleys situated at the top of the loom, in a frame called the table of mallets, and the harnets or heddles are suspended by them.

By this arrangement it will be seen, that when any one of the cords faftened at F is pulled down, it must draw one of the strings H, and fafe each an arrangement of the harnets or heddles as is proper to produce the figure which is to be woven. The weight b draws the cord fo as to keep it straight; all that is therefore neceffary is to draw down the cords at F one at a time, but to take a different one each time, and thus fafe a different feries of the heddles each time; this is the business of the machine, and which it accomplishes in the following manner.

The bar, or axis, A A, has an iron femicircle, d, grooved like a pulley, and each of its ends divided, fo as to form a cleft-hook or claw.

Each of the strings made faft at F has a large knot tied m it, juft beneath where it paffes through the brafs plate e e, and which knot flops the farther ancent of the cord, in confequence of the pull of the weight b. Now when the axis A vibrates backwards and forwards by the trebles of the loom, as before mentioned, the hook of the femicircle d feizes the knot of one of the cords F, and draws down that cord, and safe the heddles belonging to it. The weaver throws the shuttle, and then returns the trebles, and the axis A with the femicircle returns back again, and allows the cord F to take its original position. When the femicircle d inclines over to the other fide, its opposite hook takes hold of the cord F, which is next to the one opposite to that which it just quitted; it draws down this cord, and the weaver again throws his shuttle, then returns the femicircle to the opposite fide, and it will take the cord next to the opposite one, and fo on; fo that the femicircle will in fucceffion take every alternate cord in each of the rows c c, and leave every other.

This is effected by the femicircle gliding along its axis A every time, by means of two wooden racks, b and i, in the plan, which are let into grooves in the axis A; these racks have teeth like faws, but inclined in contrary directions. The racks move backwards and forwards in their grooves, the extent of a tooth at each vibration of the axis, by the action of two circular inclined planes of iron faftened to the frame at I M, against which the ends of the racks are thrown by spiral fprings concealed beneath each rack. The femicircle is fixed on a box or carriage N, which slides upon the axis A, and has two clicks upon it; one at l, which falls into the teeth of the rack b; the other at m for the rack i; n is a roller fixed over the box, and connected with the two clicks l and m, by threads wound in opposite directions; fo that one click is always raised up, and disengaged from its rack, while the other is in action. O is a piece of wire fixed to the frame, fo as to intercept a small wire projecting from the roller when the axis is inclined, and turn the roller a small quantity; P is another wire for the fame purpofe, but fixed to a cross bar, Q, which is movable, and can be faftened at any required place, farther or nearer from the end of the axis. Suppose the roller n to be in fuch a pofition that the click m is down, and l drawn up, the motion will be as follows: the femicircle frit inclines to the direction of fig. 2, its hook taking down one string; during this motion the end of the rack i comes to the inclined part of the circular inclined plane M, and moves by its fpring towards D, the fpace of one tooth, which the click m falls into. On the return of the axis, the rack i is thrufh back, and the box N and femicircle with it towards L, caufing the hook to take the next oppofite string: in this manner it proceeds, advancing a tooth each vibration, till it gets to the end of its course; the tail of the roller n then strikes againft the pin P, and turns the roller over, raifes the click m, and lets down the other, l, into the teeth of the rack b; this was all the time moving in a contrary direfion to i, by its inclined plane L, but had no action, as its click l was drawn up; this being let down, the femicircle is moved back, a tooth at a time, towards M, until it meets O, which upfets the roller n, and fends the femicircle back again.

Tweedled Silks.—In weaving very fine filk tweeds, such as those of sixteen leaves, the number of threads required to be drawn through each interval of the reed is fo great, that if they were woven with a fingle reed, the threads would obftact each other in rifing and finking, and the fped, or opening of the divided warp, would not be sufficiently open to allow the fhuttle a free paffage. To avoid this inconvenience, other reeds are placed behind that which fhirks up the web; and the warp-threads are fo difpofed, that thofe which pafs through the fame interval in the firft reed are di­vided in paffing through the fecond, and again in paffing through the third. By these means the obftacufe, if not entirely removed, is greatly leffened.

In the weaving of plain thick woollen clothes, to prevent obftacufe of this kind arifing from the elofenes and rough­ness of the threads, only one-fourfth of the warp is funk and raised by one treadle, and a fecond is preffed down to complete the fhed between the times when every fhot of weft is thrown across.

Double Cloth is compofed of two webs, each of which consis
WEAVING.

Conflicts of separate warps and separate wefts, but the two are interwoven at intervals. The junction of the two webs is formed by passing each of them occasionally through the other, so that any particular part of both warps will be found sometimes above and sometimes below.

This species of weaving is almost exclusively confined to the manufacture of carpets in this country. The material employed is dyed woollen, and as almost all carpets are decorated with fanciful ornaments, the colours of the two webs are different, and they are made to pass through each other at such intervals as will form the patterns required. Hence it happens that the patterns at each side of the carpet are the same, but the colours are reversed. Carpets are usually woven in the draw-loom, or with the machine called the draw-boy before described.

Marfelle is a fabric woven of cotton, which is a double cloth. The loom for weaving Marfelles is somewhat similar to the diaper loom. A good idea of the manner in which it is prepared may be had, by conceiving two webs woven one under the other in the same loom, which are made to intermingle at all the depressed lines, and form the reticulations on the surface, in imitation of the quilting performed by hand.

When the species of Marfelles, called Marfelles quilting, is made, a third warp, of softer materials than the two others described, lies between them, and merely serves as a sort of stuffing to the hollow squares formed by them.

Quilting is another fort of cotton stuff, solely appropriated to quilts, which should, in strictness, be set down exclusively to the cotton manufacture, although there is nothing to prevent its being made of other materials.

The weft of those quilts is of very coarse and thick yarn, which is drawn out by a small hook into little loops, as it is woven, that are so arranged as altogether to form a regular pattern; every third or fourth flout of the shuttle, the weaver has to stop to form those loops from a draft, which causes the weaving of those quilts to take up more time than that of any other stuff, except tapestry; which accounts for the great expense of the price at which they are sold, in proportion to the value of the materials of which they are principally composed.

Gauze differs in its formation from other cloths, by having the threads of the warp crossed over each other, instead of lying parallel. They are turned to the right and left alternately, and each flout of weft preserves the twine which it has received.

This effect is caused by a singular mode of producing the threads, which cannot easily be described without the aid of drawings.

Croft, or Net Weaving, is a separate branch of the art, and requires a loom particularly constructed for the purpose.

Spots, brocades, and lappets, are produced by a combination of the arts of plain, twilled, and gauze weaving, and as in every other branch of the art are produced in all their varieties by different ways of forming the division of the warp by the application of numerous heddles, and their connection with the tresses which move them. Indeed the great skill of the art confits in the proper management of this part of the apparatus of a loom.

Ribband Weaving.—This was formerly performed by a small common loom, weaving one ribband at a time. Ribbands are commonly striped in the length by laying a striped warp, and patterns are produced by changing the colour of the weft occasionally; sometimes an ornamented edging is formed by a succession of open loops at the borders of the ribband. Figured ribbands are also woven by a great number of tresses, but as they rarely extend to a greater number than the weaver can manage by his feet, they seldom employ a draw-loom.

Engine Loom for weaving Ribbands.—The weaver at Coventry, which is the principal seat of the ribband trade, universally employ what they call an engine-loom: it is worked by the hands and feet like a common loom, but weaves twelve, sixteen, or even twenty ribbands at once. The shuttles are of course fly-shuttles, and are driven by what is called a ladder, because it is a small frame exactly like a ladder, which slides horizontally in a groove in the lay; and every cross-bar of the ladder acts upon one shuttle from the manner of a pecker: the ladder has a handle to give it motion.

Another peculiarity of this loom is, that the ribbands are taken away as they are woven, with very few interruptions to wind up the work: for this purpose they conduct the warps over pulleys, and the ribbands also, so that both hang down in long loops. These looped parts are conducted through pulleys, which are loaded with weights, and tend always to draw the loops down, and keep the work tight.

The weight which is thus suspended by the finished ribband tends to draw it forwards at every stroke which the lay makes; and the weight which is suspended by the yarn of the warp is drawn up. When these weights have run through their respective courses, the weaver must stop to wind up the finished ribband, and unwind a fresh length of yarn. In some looms this is rendered unnecessary by a simple mechanism, which continually winds up the ribband as fast as it is woven.

In 1804 the Society of Arts rewarded Mr. Thomas Clulow, for an improved loom for weaving figured ribbands.

This loom differs from the common figured ribband-looms in the method of forming the figure, which, in the old mode, was tedious, from the work being stopped, whilst the figure was drawn by hand.

In the present loom, the tie-cords which form the figure are drawn or worked by a cord or leather-strap fixed to the centre-treadle, which strap passes over two vertical and one horizontal pulley to the back of the loom, and has a weight hung to the end thereof. Upon this strap above the weight is fixed an iron, of a bevel or flopping form, which when the strap is pulled up by pressing with the foot upon the treadle, raises a wire-lever placed across the main-wheel of the movements placed vertically, and allows this main-wheel to move one-fourth of its circumference, where it is stopped by an iron pin, placed on its rim, and prevented from returning by a clitch or catch on the edge of the wheel on its right side.

Within the rim of the main-wheel is a small catch-strap connected with the strap above-mentioned; this catch-strap pulls forward the main-wheel one-fourth of its circumference, until it is stopped by the wire-lever and one of the pins on the rim, of which there are four in number in the ground.

There are also four iron pins projecting from the left side of the main-wheel in opposite quarters of it: these act on a hanging lever, to the lower part of which a string is attached, which passes behind the box containing the whole machinery, and raises four clips or catches on four rollers, which permits any one of the four rollers to run back as the figure may require, each roller by such motion drawing up the number of threads necessary to form the figure, by cords extending from these rollers over pulleys to the pafs-cords, which draw the figure.

Machine Loom for Ribbands.—We have before mentioned M. Vaucanfon's loom for weaving ten ribbands by a rotatory motion. We do not know that this is in use in this country.
Mr. James Birch invented an improvement on the swivel-loom, so as to weave satin-guard or figured laces, and received a reward from the Society of Arts in 1824.

This loom is worked by a circular motion of the hands, without treads, or any application of the feet.

A wooden bar, to which the hands are applied, works two cranks on a large iron axle, extending the width of the loom; one crank is near each end of the above axis. A fly-wheel is attached to one of the ends of the axis, to regulate the motion of the machinery; an endless screw is placed upon the axis, works a star-wheel underneath it, which turns a barrel that has a resemblance to that of a hand-organ, and has wooden pegs fixed in different parts around it; these pegs catch upon levers, which draw forward the cords that form the figure, and pull them down by a claw, which secures the cords thus brought within its power, and by those means raise the upper gear connected with the cords.

In this loom fourteen pieces of satin-guard or bed-lace are wove at the same time, either one pattern and breadth, or all of different patterns and breadths, as may be required. The figure may be extended to any number of shafts defined.

The loom takes up no more space than a common swivel-loom, such as is employed in plain-work. It appears to work with ease and expedition, to make good work, and to be easily managed. It does not break or chafe the silk during its working. The weaver can move to any part of the front of the loom to inspect the work, and to continue the motion during that time; and the figure or pattern may be formed double the length of those usually done in the engine-loom. The loom can be stopped when required, at any one shoot of the shuttle; and it will answer to weave articles made of silk, wool, cotton, or linen, or mixtures of those articles, or gold or silver lace, and performs its work in half the time of an engine-loom.

The want of uniformity in the technical phraseology of the art of weaving, and the intricacy of the subject, have compelled us to render our descriptions far more intricate and difficult than they otherwise would have been.

We must acknowledge the assistance which we have derived from the very excellent "Essays on the Art of Weaving," by Mr. Duncan, 1828, in 2 vols. 8vo. It is a most curious and valuable publication, embracing almost every thing necessary to be known concerning the art on which it professes to treat; if we except some of the recent improvements in machine-weaving, which are only slightly noticed.

The French have long excelled in the various branches of figure-weaving; but this is more from dexterity of their weavers than from their machinery. Descriptions and drawings of all looms used by them, with every detail of their structure, will be found in the different articles of "L'Encyclopédie Methodique, and Les Arts et Métiers, D'Art de Fabriquer le Sole, &c."

*Weaving of Cloth, Cotton, and Silk.* See *Weaving supra.*

*Weaving of Tapestry, &c.* See *Tapestry, &c.*

*Weaving, Stocking.* See *Stockings.*

*WEAUME,* in Geography, a river of France, which runs into the sea, near Marfaillies.

*WEAUS,* or *WEES,* Indians dwelling near the head of the river Wahaah.

*WEAUTENANS,* Indians of North America, about N. lat. 40° 20'. W. long. 87° 20'.

*WEB,* a fort of plexus, or texture, formed of threads interwoven with each other; some of which are extended in length, and called the *swarp,* and others drawn across them, called the *woof or weave.* See *Weaving supra.*

*WEB* is also a technical term for all weavers and bleachers, both in Great Britain and Ireland, for a piece of linen cloth.

*WEB, Spider's, or Cob-Web,* is a very delicate and wonderful plexus, which that spin out of its own bowels; serving it as a form of toil, or net, to catch flies, &c. See *SPIDER.*

For the manner in which the spider spins his web, the admirable machine of the parts subervient to it, and the use of it, see *SILK,* and *Dulility of Spider-Webs infra.*

Dr. Lister tells us, that, attending nearly to a spider weaving a net, he observed it suddenly to defray in the midst of it, and turning its tail to the wind, it darted out a thread, with the violence and stream we see water spout out of a jet: this thread, taken up by the wind, was immediately carried to some fathom long; still issuing out of the belly of the animal. By-and-by the spider leaped into the air, and the thread mounted her up swiftly. After this discovery he made the like observation in nearly thirty different sorts of spiders, and found the air filled with young and old, foaming on their threads, and doublets king gnats and other insects in their passage; there being often manifest signs of slaughter, legs and wings of flies, &c. on these threads, as well as in their webs below.

Dr. Hulse discovered the same thing about the same time. In a letter to Dr. Lister, he thinks there is a fair hint of theArts in France, which runs into the sea, near Marfaillies.

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Dr. Hulse discovered the same thing about the same time. In a letter to Dr. Lister, dated January, 1670, speaking of the height spiders are able to fly to, he says, "Last October, &c. I took notice that the air was very full of webs; I forthwith mounted to the top of the highest tree on the minifier (in York), and could there discern them yet exceeding high above me."

*Dulility of Spider-Webs.* M. Reaumur observes, that the matter of which spider's and silk-worms form their threads, is brittle when in the masts, like dry gums. As it is drawn out of their bodies, it assumes a consistence, much as glass-threads become hard, as they recede from the lamp, though from a different cause. The dulility of this matter, and the apparatus for this purpose, being much more extraordinary in spiders than in silkworms, we shall here only consider the former. Something else has already been said of each under SILK.

Near the anus of the spider, there are five or six papillae, or teats. The extremities of the several papillae are furnished with holes, that do the business of wire-drawers, in forming the threads. Of these holes, M. Reaumur observes, there are enough in compass of the smallest pin's head, to yield a prodigious quantity of distinct threads. The holes are perceived by their effects: take a large garden-spider ready to lay its eggs, and applying the finger on a part of its papilla, as you withdraw that finger, it will take with it an amazing number of different threads. M. Reaumur has often counted seventy or eighty with a microscope, but has perceived that there were infinitely more than he could tell. In effect, if he could tell, that each tip of a papilla furnished a thousand, he is perfused he should say much too little. The part is divided into an infinity of little prominences, like the eyes of a butterfly, &c. each prominence, no doubt, makes its several threads; or rather, between the several protuberances, there are holes that give vent to threads; the use of the protuberances, in all probability,
bility, being to keep the threads at their first exit, before they are yet hardened by the air, adipifer. In some spiders those protuberances are not so feifible: but in lieu thereof there are tufts of hair, which may serve the same office, viz. to keep the threads apart. Be this as it will, there may threads come out at above a thoufand different places in every papilla; consequently, the spider having four papillae, has holes for above fix thoufand threads. It is not enough that these apertures are immensely small, but the threads are already formed before they arrive at the papilla, each of them having its little sheath or duct, in which it is brought to the papilla from a considerable distance.

M. Reaumur traces them up to their source, and shews the mechanism with which they are made. Near the origin of the belly he finds two little soft bodies, which are the first source of the silk. Their form and transparence resemble those of glass-beads, by which name we shall hereafter denote them. The tip of each bead goes winding, and makes an infinity of turns and returns towards the papilla. From the base, or root of the head, proceeds another branch much thicker; which winding variously, forms several knots, and takes its course like the other, towards the hind part of the spider. In these beads and their branches, is contained a matter proper to form the silk, only that it is too soft. The body of the bead is a kind of reservoir, and the two branches two canals proceeding from it. A little farther backwards, there are two other leffer beads, which only fend forth one branch a-piece, and that from the tip. Beside these, there are three other larger vessels on each side of the spider, which M. Reaumur takes for the laft reservoirs, where the liquor is collected. The biggest is near the head of the insect, and the leafl near the anus. They all terminate in a point; and from the three points of these three reservoirs it is, that the threads, at leat the greatest part of the threads drawn out at the three papillae, proceed. Each reservoir supplies one papilla. Lastly, at the roots of the papilla, are difcerned several lefhy tubes; probably, as many as there are papillae. Upon lifting up the membrane, or pellet, that seems to cover these tubes, they appear full of threads, all diftinct from each other, and which, of confequence, under a common cover, have each their particular one; being kept like knives in sheaths. The immense quantity of threads contained here, M. Reaumur concludes, upon tracing their course, does not wholly come from the points of the reservoirs; but come from all the turns, and angles: nay, probably from every part of it. But by what conveyances the liquor comes into the beads, and out of the beads into the reservoirs, remains yet to be discovered.

We have already observed, that the tip of each papilla may give passage to above a thoufand threads; yet the diameter of that papilla does not exceed a small pin’s-head; but we were there only considering the largest spiders.

If we examine the young growing spiders produced by those, we shall find, that they do no sooner quit their eggs, than they begin to spin. Indeed their threads can scarce be perceived; but the webs may: they are frequently as thick, and clofe, as those of honef-fpiders; and no wonder; there being often four or five hundred little spiders concouring to the same work. How minute must their holes be? the imagination can scarce conceive that of their papilla! The whole spider is, perhaps, lefs than a papilla of the parent which produced it.

This is easily feen; each big spider lays four or five hun-
dred eggs; these eggs are all wrapped up in a bag; and as soon as the young ones have broke through the bag, they begin to spin. How fine must their threads at this time be!

Yet is not this the utmost nature does: there are some kinds of spiders so small at their birth, that they are not visible without a microscope. There is finally found an infinity of these in a cluster, and they only appear like a number of red points. And yet there are webs found under them, though well nigh imperceptible. What must be the teniency of one of these threads; the smallest hair must be to one of these what the most massive bar is to the finest gold-wire.

The matter of which the threads are formed, we have observed, is a viscid juice. The beads are the firl receptacles where it is gathered, and the place where it has the least confequence. It is much harder when got into the fix great reservoirs, either it is carried by canals from the former; this confequence it acquires in good measure in its passage, part of the humidity being dilipated in the way, or fecrated by parts defined for that purpofe.

Lastly, the liquor is dried till farther, and becomes thread, in its progress through the respective canals to the papilla. When these fhrill appear out at the holes, they are fll glutinous; fo that fuch as spring out of neighbouring holes stick together. The air completes the drying.

By boiling the spider, more or lefs, the liquor is brought to a greater or lefs confequence, fit to draw out into threads; for it is too fluid for that purpofe while yet inclosed in its reservoirs.

The matter contained in thefe reservoirs, when well dried, appears a transparent gum, or glue, which breaks when much bent; like glass, it only becomes flexible by being divided into the fmal threads. And probably it was on this account nature made the number of holes fo immense. The matter of filk formed in the bodies of spiders being much more brittle than that formed in filk-worms, needed to be wound smaller. Otherwife we do not conceive, why they should form a great number of threads, which were afterwards to be re-united: a fingle canal might elfe have done.

The thread of a spider being strong enough to bear five or six times the weight of the spider’s body, is composed of several finer threads, that are drawn out separately, but unite together at the distance of two or three hairs breadth from the body of the spider. The threads are coarse or finer, according to the fize of the spider that spins them. Mr. Leewenedecke computes that 100 of the finest threads of a full grown spider, are not equal to the diameter of the hair of his beard; and consequently, if the hair be round, 1,000 fuch threads are not bigger than fuch a hair. He calculated farther, that when young spiders first begin to spin, 400 of them are not larger than one that is full-grown; and therefore the thread of a little spider is 400 times smaller, than the thread of a full-grown one; allowing this, four millions of a young spider’s threads are not f0 big as the fingle hair of a man’s beard.

WEB, in Ship-Building, the thin partition on the inside of the rim, and between the spokes of an iron or brass-heap.

WEB of a Coabter, in Agriculture, that part of it which is drawn out thin and sharp, in order to cut and separate the ground, in opposition to the others which are thick and blunt. In the lock, too, any thin sharp part has the name of web or wing.

WEB on the Eye, among Animals, a term sometimes used to signify a film on that part. See Eye, Filn, and White Film.
WEB-Caf. See CHRYSLALIS.
Web, Pin and. See PANNUS.

WEBB, PHILIP-CARTERET, in Biography, a member of the society of antiquaries, was born in 1700, and admitted an attorney in 1724, and distinguished for his acquaintance with the records of the kingdom, and with constitutional and parliamentary law. He was returned in 1754, and again in 1761, as a member for the borough of Hallemere; and being attached to the then existing administration, he obtained the place of secretary of bankrupts in the court of chancery, and in 1756 became one of the joint solicitors of the treasury. He was employed in 1763 in conducting the prosecution against Mr. Wilkes, for writing a number of the North Briton; and printed on that occasion "A Collection of Records about General Warrants," and "Observations on discharging Mr. Wilkes from the Tower." He died at his house in Belfordbridge, Surrey, in June 1770, and left a valuable library, and curious collection of coins, medals, and relics of antiquity, which were sold by auction. He had sold 30 MSS. of the rolls of parliament to the house of lords, and a number of other MSS. were sold to lord Shelburne, and afterwards to the British Museum. Among his publications we may reckon "A Letter to the Rev. Mr. Warburton, on some passages of his Divine Legation;" "Various Pieces relative to the State of the Law in this Kingdom;" "Account of some Particulars concerning Domeday Book;" "A Short Account of Danelagel;" "Account of a Copper Table, discovered near Heraclea." Mr. Webb was twice married, and by his first wife left a son of his own name. Nichols's Lit. Anecd. Gen. Biog.

WEBB Pond, in Geography, a town of the district of Maine, in the county of Oxford, containing 318 inhabitants.

WEBBER, JOHN, in Biography, who accompanied captain Cook in his last voyage to the South sea, in the capacity of draughtsman, was a native of London, though his father was a Swifs. He was born in 1752, and was sent young to Paris for his education as an artist. After his return he studied at the Royal Academy, of which in 1785 he became a member. His talents for drawing landscape recommended him to the lords of the admiralty, who appointed him to go with captain Cook on his voyage of discovery; and when the vessels returned in 1780, they also commissioned him to superintend the engraving of the prints from his own drawings of the scenes he had beheld. When these were completed, he was permitted to publish a work containing of other views which he had made, which he etched and aquatinted himself, and published on his own account; and these produced him a handsome remuneration. He afterwards applied himself to painting, but his pictures are weak and unsubstantial, without colour or effect, or any great degree of merit, though they please from their neatness and minuteness. He died in 1793, aged 41.

WEBERA, in Botany, owes its name to Schreber, who dedicated this genus to the memory of George Henry Weber, late professor of medicine and botany at Kiel; an excellent cryptogenic botanist, most celebrated for his Speci- legium Flora Gottingensis, published in 1778, and one of the classical works in that department of the science. He died in 1786, at the age of 35. Hedwig had previously commemorated Weber in a genus of Moffs, some species of which are now referred to Bartramia, others to Bryum. (See Musci and Frigic of Moffes.) It is to be regretted that Weber did not take place of Bartramia, the person after whom the latter was named, however meritorious, being scarcely at all convervant with mosses.—Schreb. Gen. 794.


cus, Juff.

Gen. Ch. Cal. Perianth superior, of one leaf, divided half way down into five erect, acute, permanent segments. Cor. of one petal, filament-shaped; tube cylindrical; longer than the calyx: limb in five ovate-oblong, reflexed segments. Nectary a fliehy ring, surrounding the base of the fyle. Stam. Filaments five, very short, inserted into the margin of the tube; anthers linear, incumbent, spreading. Pist. German roundish, inferior; style simple, longer than the tube of the corolla; stigma club-shaped, with ten furrows. Peric. Berry nearly globular, of two cells, crowned with the permanent enlarged calyx. Seeds from two to four in each cell, angular.


A genus of evergreen East Indian shrubs, with opposite branches and leaves; and axillary or terminal, aggregate flowers, which are occasionally augmented in the number of their divisions and flaments, from five to six. Canthium of La- marck's Dict. v. 1. 602. Juff. 204. Cavan. Ic. v. 5. 21. confounded by Willdenow with this genus, is certainly very diffeft in its habit, peltate illaia, solitary fields, and four-fock flowers.


Leaves elliptic-oblong. Corymbs terminal, forked, manflowered.—Native of sandy ground in the East Indies; cultivated by Miller in the June at Chelsea, in 1759, but it is not recorded by Mr. Aiton to have flowered, nor do we recolcct having ever seen the plant in any collection. A wild specimen from Dr. Rottler is before us. The flim is shrubby, about the height of a man, with smooth, leafy, somewhat compressed, branches. Leaves on short thick stalks, entire, connate, very smooth, four inches long, rather acute, with a flout rib, and numerous reticulated veins; their upper side shining; lower paler. Stipulas in- trifolaceous, triangular, short, pointed. Flower-stalks hairy. Flowers three-quarters of an inch long, whitish, agreeably fragrant, turning yellowish as they fade. Berries firm, the size of a currant, blackish, sweetish, but not edible. Rheede describes 7 or 8 seeds in each fruit.

This plant has the appearance of an Isora or Pavetta, as we have observed at the end of our article Onondeletia; but perhaps the stigma, very important in this natural order, may keep it distinct.

2. W. cymosns. Corymbose Webera. Willd. n. 2. "Leaves ovate, pointed. Cymes axillary, forked, many-flowered."—Native of the East Indies. "A tree, with round downy branches. Leaves forked, ovate, obtuse with a point, entire, very smooth, rigid, simply veiny; shining above. Cymes convex. Flower-stalks downy. Corolla half the size of the former. Style much longer than the corolla. Stigma capitate, cloven. Berry the size of Juniper."—Willdenow, from a dried specimen.—We have not seen this species. The description of the stigma does not answer to the generic character.

WEBHATET, in Geography, a river of the district of Maine, which runs into the Atlantic, near Wells.

WEBUCH,
WEBUCH, Cape, a cape on the E. coast of Labrador. N. lat. 55° 21'. W. long. 56° 16'.

WECHMAR, or Warhmur, a town of Germany, in the principality of Gotiah; 4 miles S.E. of Germany.

WECHQUETANK, or Moravian settlement in Pennsylvania; 30 miles N.W. of Bethlehem.

WECHSELBURG, a township of Germany, in the lordship of Schonburg; 4 miles N.E. of Penig.

WECHSTEN, a town of Germany, in the county of Verden; 12 miles S.E. of Verden.

WECHTERBACH, a town of Germany, in the county of Henburg; 7 miles S.E. of Badingen.

WECHTERSWINCKEL, a town of the duchy of Wurtzburg; 3 miles N.W. of Neufadt am Saal.

WECKHOLM, a town of Sweden, in the province of Upland; 22 miles S.W. of Upfal.

WED EL CASAAB, a river of Algiers, which runs into the Mediterranean, 5 miles S. of Cape Falcon.

WED el Kibheer, a river of Algiers, ancieniy called Amsfaga, which runs into the Mediterranean, 15 miles S. of Sebbia Rous. N. lat. 36° 57'. E. long. 6° 28'.

WED el Mallab, i. e. the Salt River, a river of Algiers, which runs into the Mediterranean, 10 miles S.S.E. of Cape Figalo.

WED el Slonier, a river of Africa, which rises about 12 miles E. from the mountain of Zeckar, in the Sahara, and after a north-eaft course about 30 miles changes its name to Mallab, and finally lofs itself in the Short.

WEDDER, the name of a certain flate of sheep. See Wether-Sheep.

WEDDRA, in Commerce. See Vedro.

WEDEKINSTEIN, in Geography, a town of Westphalia, in the principality of Minden; 3 miles S.W. of Minden.

WEDEL, George Wulfgang, in Biography, an eminent physician, who was born in 1645; at Golzan, in Lufatia, and studied physic and anatomy. He took his degree as a student at Jena, in 1667, where, after a temporary exercise of his profession at Gottha, he became medical professor, in which station he continued with reputation for about fifty years. He combined with his medical skill a considerable acquaintance with mathematics and phihology, as well as with the oriental and classical languages. He was an active in the Academy Naturae Curiosorum, and to the Royal Society of Berlin, pbycian to sever al German sovereigns, a count palatine, and an imperial counsellor. Notwithstanding these high offices and numerous engagements, he was attentive to the poor, and affidious in his literary labours. His pathology was derived from the slylem of Helmont and Sylvius; in his practice he depended much on absorbents, and the volatile salts of vegetables. Wedel was addicted to alchology; but he is chiefly celebrated for his pharmaceutical knowledge, and his elegance of prescription, so that many of his compositions have been adopted in dispensatories. Of his works, besides his academical diferentions, the principal are the following: siv. " Opiologia;" "Pharmacia in Artis formam redacta;" "De Medicamentorum Facultatibus cognoscendis et applicandis;" "De Morbis Infantum;" and "Exercitaciones Medico-Philologice." Haller. Eloy.

WEDEL, in Geography, a town of Holstein; 13 miles N.W. of Hamburg.—Alto, a town of the New Mark of Brandenburg; 11 miles E. of Reetzz.

WEDELIA, in Botany, was so called by Jacquin, in honour of Dr. John Wolfgang Wedel, of Jena, whom he celebrated as a highly meritorious botanist, and who wrote "Tentamen Botanicum," published at Jena in 1747, with a preface by his friend Hamberger. The design of this work is to combine the slylems of Riviuzus and Linnaeus, the classes of the latter making substitutions of the former. We presume that no scheme could be left natural or useful, whatever the botanical skill of the author might be; of which indeed we are not disposed to think highly, as he made a point of excluding the fruit from his principles of classification. He wrote a German essay against Haller, on the subject of botanical terms, of which the latter speaks as full of taunts and reproaches. Wedel died in 1757, at the age of 42. Some others of the same name, and probably the same family, who were Professors at Jena, appear full as well entitled to botanical honours; especially George Wolfgang Wedel, who died in 1721, aged 76, and has left behind him numerous dissertations on botany and the materia medica.—Jacq. Amer. 217. Wildl. Sp. Pl. v. 3. 2334. Jull. 189. Oeetn. v. 2. 435. (Aeliza; Cavan. Ic. v. 1. 10. Ait. Hort. Kew. v. 5. 164.)—Clas and Order. Synagogen Polygaggia-necessaria. Nat. Ord. Compo- sitea opposittifolae, Linn. Corymbises, Jull.

Gen. Ch. Common Calyx simple, of four or five large leaves. Cor. compound, radiant. Florses of the disk perfect, numerous, funnel-shaped, five-creft, those of the radius from eight to twelve, roundish-ovate, cloven. Stam. in the flowers of the disk. Filaments five, capillary short; anthers united into a tube, as long as the partial corolla. Pifl. in the fame flowers, Gerem minute, imperfect; flyle thread-shaped, the length of the anthers; stigma simple or divided; in the flores of the radius, Gerem oblong, quadrangular; flyle thread-shaped; stigmas two, revolute. Peric. none, the calyx remain unaltered. Seeds in the dille imperfect; in the flores of the radius solitary, obovate, gibbous, crowned with four, five, or ten teeth. Recept. chaffy, slighfly convex; the scales ovate, concave, as long as the flores.

Eff. Ch. Receptacle chaffy. Seed-crown of from five to ten teeth. Calyx simple, of four or five leaves.

Obf. This genus is separated from POLYMMIA, (see that article,) on account of its simple calyx, and the presence of a crown to the seeds, which appear to us sufficient characters.

1. W. frutescens. Shrubby Wedelia. Wildl. n. 1. Jacq. Amer. 217. t. 130. (Polymania Wedelia; Linn. Mant. 118. Poiret in Lami. Dict. v. 5. 506.)—Stem shrubby. Leaves diffinet, falked, lanceolate. Seed-crown of ten teeth.—Native of Carthagecia, South America, in bulbous woody places, flowering in July and August. Stem shrubby, climbing, with round leafy branches, rough in our specimen with minute points. Leaves acute, two or three inches long, somewhat serrated, brilily on both fides; the upper rough with callous points; lower paler. Foot-flaiks linear rough, hardly half an inch in length, combined at the bafe by a narrow annular stipula. Flowers terminal, flalked, solitary, yellow, near an inch broad, with a rough calyx; the outer scales of their receptacle looking like a coloured inner calyx. Seeds, according to Jacquin, each with a lime cup-shaped crown, having about ten teeth.

2. W. perfoliata. Perfoliate Wedelia. Wildl. n. 2. (Aeliza perfoliata; Cavan. Ic. v. 1. 11. t. 15. Ait. Hort. Kew. v. 5. 164.)—Stem herbaceous. Leaves rhomboidal, tapering at the bafe, perfoliate. Seed-crown of five teeth. —Native of Mexico, from whence its seeds were brought to Madrid, and thence dispersed through the botanic gardens of other parts of Europe. This is an annual plant, with nothing to attract the attention of florists. It flowers late, and does not always ripen seed in England. The stem is four feet high, angular or furrowed, leafy, branched, nearly smooth, often purplish. Leaves three or four inches long.
long, including their narrow base, pointed, serrated, triple-ribbed, light green, roughish. Flowers yellow, stalked, much smaller than the foregoing. Calyx broad, extending far beyond the rays. Seeds of the marginal floras large, tumid, each crowned with four, five, or more, irregularly placed tubercles, or teeth, not agreeing precisely with the crown of the first species, but scarcely affording sufficient reason to form a generic distinction.

WEDENSCHWEIL, in Geography, a town of Switzerland, and principal place of a bailiwick, in the canton of Zurich, on the S.W. coast of lake Zurich; 9 miles S. of Zurich.

WEDGE, Cuneus, in Mechanics, the half of the five powers, or simple machines.

The wedge is a triangular prism, whose bases are isosceles acute-angled triangles.

Authors are divided about the principle whence the wedge derives its power.

Aristotle considers it as two levers of the first kind, inclined toward each other, and acting opposite ways. Guido Ubaldus, Merfennus, &c. will have them levers of the second kind. But Fra. de Sanshew shows, that the wedge cannot be reduced to any lever at all.

Others refer the wedge to the inclined plane. Others, again, with Dr. Stair, deny the wedge to have force any force at all; and ascribe much the greater part to the mallet that drives it.

Its doctrine (according to some writers) is contained in this proposition. "If a power be applied to a wedge, in such manner, as that the line of direction C D (Plate XL. Mechanics, fig. 1.) perpendicular to A B, is to the resistance to be overcome, as A B to C D; the power will be equal to the resistance."

Or thus: "If the power directly applied to the head of the wedge, be to the resistance to be overcome by the wedge, as the thickness of the wedge is to its height, then the power will be equivalent to its resistance; and, if increased, will overcome it."

In proof of this proposition, they allege, that the firmness by which the parts of the obstacle, suppose wood, adhere to one another, is the resistance to be overcome by the wedge; and that while the wedge is driven into the wood, the way or length it has gone is B H (fig. 2.) and C D is the way or length gone in the same time, by the impediment; that is, the parts C and D of the wood are so far divided afunder: and according as the wedge is driven farther and farther along its height; so the parts C and D of the wood are divided more and more, along the thickens of the wedge.

But Dr. Desaguliers has proved, that, when the resistance acts perpendicularly against the sides of the wedge, the power is to the whole resistance as the length of both sides of the wedge, taken together, is to the thickness of its back.

According to the preceding theory, if the thickens of the wedge (that is, the way of the impediment, and consequently its velocity) be to the height of the wedge (that is, the way, and consequently the velocity of the power) as the power to the impediment, or resistance; then the momentum of the power, and the impediment, will be equal the one to the other: and consequently the power, being increased, will overcome the resistance.

Hence, 1. The power equivalent to half the resistance, is to it as A C to D C, (fig. 1.) that is, as the whole line to the co-tangent of half the angle of the wedge A D C. And 2. As the tangent of a less angle is less than that of a greater, the power must have a greater proportion to half the resistance, if the angle be greater than if less; consequently, the acter the wedge is, the more does it increase the power.

The above proportion is adopted by Wallis, (Op. Math. vol. i. p. 1016.) Keill, (Int. Ad Ver. Phys.) and S'Gravefande. (El. Math. lib. i. cap. 14.) but S'Gravefande, in his Scholiun de ligno finendo (ubi supra), observes, that when the parts of the wood are separated before the wedge, the force by which it is thruf in is to the resistance of the wood as a line, drawn from a point in the middle of the base to the side of the wedge, and at right angles with the side of the leperated wood continued, to the height of the wedge; but when the parts of the wood are separated no farther the wedge is driven in, the equilibrium will be, when the power is to the resistance as the half base of the wedge to its side.

To this method of estimating the power of the wedge it has been objected that, by allowing each part of the weight to have moved through a space equal to half the back of the wedge, the wedge has moved through its length, and the whole weight to have moved through a space equal to the whole back, the whole is made to move farther than its parts.

M. Mofchenbroeck flates the proportion of the power to the weight in a simple wedge, or half the wedge (fig. 1.) biecting it by a plane passing through C D, as its back is to its length, or in that case as A C to C D; and in a double wedge or the wedge A B D, as A B to 2 C D. Int. ad phil. vol. i. p. 132.

Mr. Ferguson estimates the power of the wedge, in the two cafes mentioned by S'Gravefande, in the following manner. When the wood does not cleave at any distance before the wedge, there will be an equilibrium (he says) between the power impelling the wedge downward, and the resistance of the wood acting against the two sides of the wedge, if the power be to the resistance as half the thickens of the wedge at its back is to the length of either of its sides; and if the power be increased so as to overcome the friction of the wedge, and the resistance arising from the cohesion or fikkage of the wood, the wedge will be drove in, and the wood split afunder.

But when the wood cleaves at any distance before the wedge (as it generally does), the power impelling the wedge will be to the resistance of the wood as half its thickens is to the length of either side of the cleft, estimated from the top or acting part of the wedge; for supposing the wedge to be lengthened down to the bottom of the cleft, the power will be to the resistance as half the thickens of the wedge is to the length of either of its sides; or, which amounts to the same thing, the whole thickens of the wedge is to the length of both its sides.

In proof of this proportion we may suppose the wedge divided lengthways into two equal parts, and then it will become two equally inclined planes; one of which, as a b c (fig. 3.) may be made use of as a half-wedge for separating the moulding ed from the waincot A B. When this has been driven its whole length a c between the waincot and moulding, its side a c will be at ed, and the moulding will be separated to f g from the waincot.

From the property of the inclined plane, it appears, that to have an equilibrium between the power impelling the half-wedge and the resistance of the moulding, the former must be to the latter, as a b c to a c; that is, as the thickens of the back which receives the stroke is to the length of the side against which the moulding acts. Consequently, since the power upon the half-wedge is to the resistance against its side, as the half back a b is to the whole side a c, it is plain,
plain, that the power upon the whole wedge (where the whole back is double the half back) must be to the reffistance against both its fides, as the thicknefs of the whole back is to the length of both the fides, suppoing the wedge at the bottom of the cleft; or as the thicknefs of the whole back to the length of both fides of the cleft, when the wood fplits at any diftance before the wedge. For when the wedge is driven quite into the wood, and the wood fplits at ever fo small a diftance before its edge, the top of the wedge then becomes the acting part, because the wood does not touch it any where elfe. And since the bottom of the cleft muft be conidered as that part where the whole thicknefs or reffistance is accumulated, it is plain from the nature of the fide, that the farther the power acts from the reffistance, the greater is the advantage.

Some writers have, indeed, advanced, that the power of the wedge is to the reffistance to be overcome, as the thicknefs of the back of the wedge is to the length only of one of its fides; but this, fays Mr. Fergufon, feems very extravagant; for, if we fuppofe $A B$ (fig. 4.) to be a strong inflexible bar of wood or iron fixed into the ground at $C$, $D$, and $E$ to be two blocks of marble lying on the ground on opposite fides of the bar; it is evident that the block $D$ may be feparated from the bar to the diftance $d$ equal to $a b$, by driving the inclined plane or half-wedge $a b$ down between them; and the block $E$ may be feparated to an equal diftance on the other fide, in like manner, by the half-wedge $e d o$. But the power impelling each half-wedge will be to the reffistance of the block against its fide, as the thicknefs of that half-wedge is to the length of its acting fide. Therefore the power to drive both the half-wedges is to the reffistances, as both the half backs are to the length of both the acting fides, or as half the thicknefs of the whole back is to the length of either fide. And, if the bar be taken away, the blocks put clofe together, and the two half-wedges joined to make one; it will require as much force to drive it down between the blocks, as is equal to the fum of the feparate powers acting upon the half-wedges when the bar was between them. 

Fergu fon's Left. p. 40, &c. 40. See also Defag. Exp. Phil. vol. i. p. 107. &c.

Mr. Ludlam, in an Essay on the Power of the Wedge, printed in 1740, propofes, with a particular view to the machines defcribed by S'Gravefande, Defagulars, and Fergu fon, for efimating the power of the wedge, to determine this power, when two equal forces act on the fides of an ifofceles triangle in directions parallel to the back but oppofite to each other, and are futfined by a third force acting perpendicularly on the back of the wedge. For this purpofe, let $A B C$ (fig. 5.) be an isofceles wedge, whose angular point is $C$, fides $A C$ and $B C$, back $A B$, and perpendicular height $H C$; let $F E$ reprefent the quantity and direction of the force applied to one of the fides; this may be refolved into two other forces $F D$ and $F E$, the former parallel and the latter perpendicular to the fide $A C$; and the oblique force $F E$ will have the fame eflence upon the wedge as a fefs perpendicular force $D E$; the former being to the latter as $A C$ is to $H C$. But this laft perpendicular force on the fide $A C$ is to that on the back which balances it as $A C$ is to $A H$; whence compounding thefe ratios, the oblique force againft one fide of the wedge is to the perpendicular force on the back which balances it, as $A C$ is to $A H \times H C$. The oblique force $j e$ on the other fide of the wedge, being equal to $F E$, will require another perpendicular force on the back to balance it equal to the former perpendicular force; whence the whole force on both fides of the wedge is to the whole force on the back as $A C$ is to $A H \times H C$; or as the square of the side of the wedge to the rectangle under half the back and the perpendicular height.

For other methods of efimating the eflence of the wedge in various cafes, see Mechanical Powers.

The wedge is a very great mechanical power, fince not only wood but even rocks can be fplitted by it; which it would be impoffible to eflence by the lever, wheel and axle, or pulley; for the force of the blow or froke, fakes the cohereing parts, and thereby makes them separate the more efily.

To the wedge may be referred all edge-tools, and inftuments which have a sharp point, in order to cut, cleave, fit, chop, pierce, bore, or the like; as knives, hatchets, fwords, bodkins, &c.

WEDGE, in Ship-Building, a triangular folid made of wood or iron. It is one of the mechanic powers, the moft fimple, and of the greatest eflence.

WEDGE ISLAND, in Geography, a small ifland in the North Pacific ocean, near the E. coast of the Prince of Wales's Archipelago, in the Duke of Clarence's Strait. N. lat. $55^\circ$ 8'. E. long. $228^\circ$ 20'.

WEDGES, in Agriculture, are a fort of levers or diftending powers that are of great ufe to the farmer on many occasions, as in tearing and fplitting wood of all forts, the roots of trees in taking them out of the ground, fones, and many other forts of hard materials. About farm-houfes of any extent, it is always of advantage to have a proper fallet and fet of wedges for tearing up wood and other matters.

WEDGWOOD, Josias, in Biography, was the younger fon of a Staffordshire potter, and born in July 1730. His education was restricted, but his mental powers were of a superior kind, fo that by the fixed and perfevering exercife of them he made very coniderable improvement in the art of pottery to which his attention was directed, and gave a name as well as reputation to the place of his nativity. (See Pottery and The Potteries.) His patrimony was small, but by his super-eminent skill and fteady application he was the founder of his own fortune as well as fame. The principal feat of the potteries of Staffordshire was Burflem; and there is reason to believe that they have exifited in or near this place for many centuries, and even, as fome fay, from the time of the Romans. But they had continued for a long time in the fame rude iflate in which Plut found them when he surveyed this county. The merit of introducing into this country improvements in the art of pottery must be ascribled to two brothers of the name of Eders, who came hither from Holland about the year 1700, and fettled in the neighbourhood of the Staffordshire potteries. They manufactured a red unglazed porcelain from a clay, which they found in the flate on which they fettled, called "Bradwell;" but this was only the brown ftone ware, in the composition of which no flint is used; but they made ufe of flint in glazing it: this falt, or muriate of soda, was thrown into the oven at a certain hage of the firing procefs, and the pieces of ware were fo dipofed as to receive the fumes of it on every part of their furfaces. The fumes, however, occafioned an alarm in the neighbourhood, which obliged them to leave the country. A fimilar manufactory, however, was soon after eftablfihed at Shelton, in the Potteries, by one of their workmen, whom name was AITbury, and who had poifefed himfelf of their fecret; and as it was found very ufeful, it was tolerated by the inhabitants, though on the day of glazing, the dene offensive fumes from fifty or fixty manufactories filled the valleys, and covered the hills through an extent of feveral miles. The white ftone ware,
and the use of ground flints in pottery, were introduced at a later period, and, as it is said, (see Parke’s Chem. Cate-
cchism,) in consequence of the following incident. About the year 1730, a potter, supposed to be the above-mentioned 
Aikin’s, who lived at Dunllable in his way to London, and 
fought a remedy for a disorder in his horse’s eyes; and the 
officer of the inn by burning a flint stone reduced it to a fine 
powder, which he blew into them. The potter, observing 
the beautiful white colour of the flint after calcination, 
instantly thought of applying the discovery to the improve-
ment of his art, and afterwards introduced the white pipe-
clays found on the south side of Devonshire, instead of the 
iron-clays of his own country, and thus produced the white 
flint ware. At first the flints were pulverized to the great 
transport of the persons employed; till the famous Brindley, 
in the early period of his life, constructed the mills that are 
now used for grinding them in a moist state. It is farther 
said, that an ingenious mechanick, named Allager, after-
wards improved the contrivances of the potter’s wheel, so 
as to give much greater precision and neatness to the work. 
But still the French pottery exceeded in beauty that of Staff-
fordshire; and about the year 1760, a considerable quantity of 
it was imported, and purchased by persons of opulence 
with the great detriment of the English manufacture. Mr. 
Wedgwood directed his attention to this article, and made 
several improvements with regard to the forms, colours, and 
composition of his manufacture; and in the year 1763 in-
vented a kind of ware for the table, which gave a turn to 
the market, and under the name of queen’s ware, conferred 
upon it in consequence of the patronage of her majesty, 
came into very general use. Its materials were the whitest 
clays from Devonshire and Dorsetshire, mixed with ground 
flint, and covered with a vitrue glaze. By varying and re-
peating his experiments, Mr. Wedgwood discovered the mode 
of manufacturing other species of earthenware and porce-
lain, excellent and beautiful, and adapted to various pur-
poses both of use and ornament. With a view of pro-
cecuting his improvement in pottery he applied to the study 
of chemistry, and for his further assistance engaged the 
ingenious Mr. Chifholm, who had been employed in a similar 
department by the celebrated Dr. Lewis, author of the 
“Commerium Philofophico-Technicum;” for whom he not 
only built a comfortable habitation near the manufactory, 
but liberally afforded him an annuity for his support under 
the decays of age, which he continued till his death. Aided 
also by the classical taste of his partner, Mr. Bentley, pot-
teries were furnished which served as models for various ar-
ticles, formed of other materials, that were held in high 
efimination. We learn from Dr. Bancroft, that almost all 
the finely diversified colours which Mr. Wedgwood applied 
to his pottery were produced only by the oysds of iron. 
In the manufacture of his beautiful Jasper ware, which ri-
valled the productions of antiquity, and which found its 
way into the collections of the curious in all parts of Eu-
rope, he employed the native sulphate of barytes, and from 
this use of it he derived great profit, until the inability of a 
servant the secret was disclosed and sold, so that others 
employed inferior workmen at a reduced salary, and thus 
prevented Mr. W. from employing his exquisite modellers 
on that branch of the manufacture.

Among other curious productions of this inventive manufac-
turer we may mention his imitation of the Barberini or 
Portland vase, which was discovered in the tomb of Alex-
ander Severus, and for which the late duchess of Portland 
paid 1000 guineas. The subscription for Mr. W.’s manu-
ufacture was at the rate of 50l. each for fifty vases, but such 
were the expenses of its execution, that the partners lost 
money by the undertaking. Mr. Webber, it is said, received 
500 guineas merely for modelling it. See Vase.

We cannot forbear in this connection noticing two cameos 
of Mr. Wedgwood’s manufacture; one of a flake in chains, 
of which he distributed many hundreds, with a view of ex-
citing the humane to afflict in the abolition of the flake-trade; 
and the other a cameo of Hope, attended by Peace and 
Art and Labour, which was made of argillaceous earth 
from Botany Bay, to which place he sent many of them, in 
order to shew what their materials were capable of, and to 
encourage the industry of the inhabitants.

To this brief account of some of the numerous produc-
tions of Mr. Wedgwood, we shall subjoin the tribute paid to 
his industry and genius by an elegant modern poet:

“Gnomes! as you now divide with hammers fine 
The granite rock, the noduled flint calcine 
Grind with strong arm, the circling chertiz betwixt, 
Your pure kaolins and petunties mix; 
O'er each red faggar's burning cave prede, 
The keen-eyed fire-nymphs blazing by your side; 
And please on Wedgwood ray your partial smile, 
A new Etruria deck's Britannia's life. 
To call the pearly drops from Pity's eye; 
Or Ray Defpair's dissipating figh, 
Whether, O Friend of Art! the gem you mould 
Rich with new tints, with ancient virtue bold; 
Form the poor fetter'd flave on bended knee 
From Britain's sons imploring to be free; 
Or with fair Hope the brightening scenes improve, 
And cheer the dreary waftes of Sydney-cove; 
Or bid Mortality rejoice and mourn 
O'er the fine forms on Portland's mystic urn. 
Whether, O Friend of Art! your gems derive 
Fine forms from Greece, and fabled gods revive; 
Or bid from modern life the portrait breathe, 
And bind round Honour's brow the laurel wreath; 
Buoyant shall fail, with Fame's historic page, 
Each fair medallion o'er the wrecks of age; 
Nor Time shall mar, nor Steel, nor Fire, nor Rust, 
Touch the hard polish of the immortal built.”

The demand for Staffordshire ware was very much increased, 
and it became a commercial article of exportation of very 
considerable value.

The district which Mr. Wedgwood inhabited became 
known for its means of population and abundance. The vi-
cinity was enriched, a new canal of importance, called 
the Grand Trunk canal, and connecting the Trent and the 
Mersey, was obtained and executed by his influence. The 
ample fortune which he acquired was liberally enjoyed, and 
benevolently applied to many purposes of private charity 
and public utility. Chemistry and the arts in their mutual 
connection were objects of his attention; and he contrived an 
instrument for measuring high degrees of heat, called a py-
rometer, of which he gave an account in the Phil. Trans. 
for 1782, 1784, and 1786. See Thermometer.

The disposition and manners of Mr. Wedgwood were no 
less estimable than the powers of his mind; so that he was 
as much the object of admiration and esteem for his moral 
as for his intellectual qualities. So much was he respected, 
and so defensible was the continuance of his useful life, that 
he died, universally regretted, at his house in Staffordshire. 
to which he gave the name of Etruria, in January 1795, in 
the 65th year of his age. Aikin’s Chem. Dict. Gent. 
Mag. Parke’s Chemical Catechism, Parke’s Essays.

WEDINNO, in Geography, a district of Sufi in the 
outhern division of Morocco, inhabited by a tribe of Arabs. 
This
This territory is adjacent to the river Akassa, called by some Wed Noon, that is, the river of Noon. Jackson states the population of Wednoon at 200,000 persons. In this district the sovereignty of the emperor of Morocco is feared acknowledged; and the difficulty of palling an army over that branch of the Atlas, which separates Sufa from Haba, sues to the Wedinomees their arrogated independence. Wednoon is a kind of intermediate depot for merchandise on its way to Soudan, and for the produce of Soudan conveyed to Mogodor. Gums and wax are produced here in abundance; and the people, living in a state of independence, indulge in the luxuries of drefs, and use many European commodities. A great quantity of gold dust is bought and sold at Wednoon. The inhabitants sometimes trade to Mogodor, but prefer selling their merchandise on the spot, as they do not wish to trust their persons with property within the territory of the emperor of Morocco. With Tombuco they carry on a constant and advantageous trade, and many of the Arabs are immensely rich. They also supply the Moors of Morocco with (flatas) convoyes through the desert, in their travels to Tombuco. The coast of Wednoon extends a long way to the southward, nearly as far as Cape Bojador. The river Akassa, commonly called the river of Non or Nun, and in some maps Daradus, is a large stream from the sea to the town of Noon, which is about fifteen miles inland, and about two miles in circumference; from hence the river becomes shallow and narrow; and it is to the southward of this river that ships are generally wrecked. The district of Wednoon is nominally in the dominions of the emperor of Morocco; but lately an army having been sent farther south than Terodin, and the Pacha Akka Ali Mouhammed ben Delamy being dead, that district has suffered neglect, and the people pay no tenth, according to the mode of raising taxes in West Barbary, viz. ten per cent. on the produce of the land, and two per cent. on that of cattle; and the emperor has recently ordered his Pacha of Haba to purchase the British flaves that had been wrecked there. This place being only thus nominally in his dominions is another impediment to the redemption of the sailors who happen to be shipwrecked about Wednoon; for if the emperor had the fame authority over this district, that he has over the provinces north of the river Sufa, measures might be adopted by the confil, acting under his orders, for their delivery, without pecuniary disbursements. Jackon's Morocco. See Vled de Nun.

WEDLOCK. See Marriage, Wife, Husband, &c.

WEDNESDAY, in Geography, an ancient market-town in the south division of the hundred of Offlow, and county of Stafford, England, is situated at a short distance from the source of the river Tame; 19 miles S.S.E. from the county-town, and 125 miles N.W. from London. In the time of the Mercians, this place had a noble castle, which was fortified by Aedelfleda, who was for some time governor of this extensive kingdom: but no part of the fortresses now remains, except a few traces of its foundations. At the Norman Conquest, the manor became a portion of the royal demesne. Henry II. bestowed it on the family of the Hornvilles, from whom it passed, after various successions, to the Beaumonts. The town is distinguished for its numerous and valuable manufactures, the principal of which are of guns, coach-barrels, iron axletrees, laws, trowels, edge-tools, bridge-bits, tippets, nails, hinges, screws, and canvas iron works of every description. For their proficiency in these various branches, the inhabitants are chiefly indebted to the abundance and excellence of the coal obtained in the immediate vicinity. This coal is indubitably the behalf in the kingdom for the smith's forge, on account of the intense heat which it produces. It extends in a variety of separate veins or strata, which are particularized by the miners with the greatest accuracy. Here is also found that peculiar species of iron-ore denominated blond-metal, used in the manufacture of horse-shoes, hammers, axes, and heavy tools. Some spits likewise abound with a sort of reddish earth, called hip, employed in painting and glazing vessels of various kinds. A weekly market on Wednesday affords the town a plentiful supply of all kinds of provisions. The population of the parish, in the return of the year 1811, was flated to be 5376, the number of houses 1604. One of the collateral branches of the Birmingham canal, entering this parish, affords the inhabitants great facility of commercial communication. The church is an ancient structure, and some writers ably relate, that it was built in the year 711, by Dudo, lord of Dudley. At one end rises a tower, supporting a lofty spire: the interior is divided into a chancel, nave, and two aisles; the latter are separated from the nave by a range of arches, supported by octagonal pillars. In the chancel are several prebendal stalls, ornamented with exquisite carved work. Here is also a variety of monuments in honour of the ancestors of the Dudley and Harcourt families, and several other ancient tombs and memorials. Round the church-yard some vestiges of the castle may be distinctly traced.—Shaw's History of Staffordshire, folio, 1798. Beauties of England and Wales, vol. xiii. Staffordshire, 1811.

WEDNESDAY, the fourth day of the week, formerly consecrated by the inhabitants of the northern nations to Woden or Odin, who, being reputed the author of magic and inventor of all the arts, was thought to answer to the Mercury of the Greeks and Romans, in honour of whom they called the same day dies Mercurii.

WEDNESDAY, As. See Ash-Wednesday.

WEDNOCH, in Geography, a river of England, which joins the Wever, near Northwich, in Cheshire.

WEDUM, a town of Sweden, in Weft Gothland; 18 miles S. of Skara.

WECHAUNG-HOO, an extensive lake of China, which divides the province of Shan-tung from that of Kiang-nan, and supplies an adjoining canal when it is deficient of water. This lake affords a charming prospect, particularly at fun-rife; when its borders fringed with woodland and pagodas on the sloping grounds behind, and the surface of the water almost covered with vessels crossing it in different directions, and by all the various modes of navigation that poles, paddles, oars, and sails, could furnish, are exhibited to advantage. Fishing forms a considerable part of the occupation of the people on this lake, and they have various modes of conducting it. Besides nets, which are in most common use, they have another method, which is more singular: to one side of a boat a flat board, painted white, is fixed at an angle of about forty-five degrees, the edge inclined towards the water on moon-light nights; the boat is so placed that the painted board is turned to the moon, from whence the rays of light striking on the whitened surface give it the appearance of moving water, on which the fish being tempted to leap as on their element, the boatman raising with a staring the board, turns the fish into the boat. Water-fowl are also taken upon this lake by a peculiar device. Empty jars or gourds are suffered to float upon the water; such objects may become familiar to the birds; the fisherman then wades into the lake with one of the empty vessels on his head, and walks gently towards a bird, and lifting up his arm draws it down below the surface of the water, without disturbing or alarming the air, and thus prefently fills the bag with which he was provided for secur
ing his prey. A similar practice exists, as we learn from Alloa, among the nations of Carthagena, upon the lake Cienego de Terias. Staunton's Embaffy, vol. ii.

WEED, in Agriculture and Gardening, any fort of uncultivated and unprofitable plant or vegetable which grows in ground, and which, in confefion of the mischief it does, requires to be extirpated and destroyed.

Weeds may be diftinguifhed, according to the different periods of their duration, into the annual, biennial, and perennial kinds.

The firft division comprehends all fuch as die after perfecfting their seeds in the firft year. Weeds of this clas, though abundantly productive in feed, and consequently in plants, are capable of being destroyed without any great difficulty.

The second division includes all fuch weeds as endure a greater length of time than one year, and which after perfecfting their seeds in the second year perifh. These, like the former, are in general abundant in the production of feeds as well as plants, but they are deftroyed with greater difficulty.

The third division comprises all thofe weeds which are capable of continuing many years. Some of which have the property of perfecfting their feeds annually, without being thereby deftroyed; while others, lefs prolific in feeds, have the faculty of reproduction in their vivaceoufs roots; and there are others that are capable of increafe both by feeds and roots. The plants of this clas are therefore much more troublome and difficult of deftruction than the others.

In the nature and vegetation of the feeds of weeds of different sorts, there is confiderable diftincfion. Some are found to sprout forth as foon as they have a fufficient degree of moistnere, fending down their roots, though not in exprefl con- taf with the earth; others only begin to germinate when they are depofited and inclofed in a fuitable foil, and have the proper infuence of the atmosphere; and there are many of thofe kinds of feeds, even of the very small fort, which are capable of remaining in a dormant or inactive flare for a very conliderable length of time, and afterwards vegetate on being placed in a favourable fiation, in regard to the infuence of the air, and other matters.

There are other feeds of weeds, too, which are provided with a soft feathery material which performs, in fome meafeure, the office of wings, by which they are conveyed from their native ftations, and difseminated over lands and places at a conliderable diftance.

There is likewife a difference of fome confecution in the vivaceoufs roots of vegetable feeds; fome being branched, others entire; fome defcending direcdy downwards, others inclining; fome fibrous, others tuberoufs; fome creeping, others knotted or jointed, &c.

The great variety and multiplicity of feeds render it a difficult matter to arrange them in any ufeful manner for the purpofes of the farmer, as different forts of them are found to prevail in different fitions and kinds of land. A late intelligent writer has, however, confidered them as affecting gardens; corn-fields and tillage-lands; meadows and paf- tures; waste and uncultivated grounds; the hedges of in- closures; and woods and plantations.

Weeds injurious to garden grounds are chiefly thefe:

Couch-grafs, or which in fome places is known by the names of twitch, squitch, and many others, and which not unfrequently comprehend the creeping roots of the hardy perennial grhaoes, which are particularly tenacious of growth, as dog's-grasfs, white bent-grasfs, tall oat-grasfs, and fome others. Of which, the two firft are readily diftinguifhed by their flowering ftalks, as well as by the ears which contain the feeds; and the laft has been obferved to have a bulbofs-jointed root, that affords shelter to various deftruc- tive grubs, worms, and infefts: thofe fhould all be carefully rooted out and deftrroyed. These are to be deftroyed in gardens by carefully picking out the roots in digging, and as carefully rooting up whatever remaining fragments of the roots may fend out a shoot above the ground. These fhould never be allowed to get to any height, but be exterminated asfoon as poflible. See Triticum Repens, Agrostis Alba, Avena Elatior, &c.

Suffolk-grafs, or dwarf meadow-grasfs, is another grafs, which, though ufeful in pastures, is a very pernicious weed in gardens and places about houfes. It is common in places where the surface is not liable to be often disturbed by means of cultivation. Its prolific quality, in refeft to feeds, is fo great, that it is faid to be capable of producing and re- producing itself four times in the course of one summer. It may be deftroyed by rooting it out before its feeds are perfed and lifted away, otherwise the vegetation of them will be fo abundant and extensive as almoft to bid defiance to the powers of the weeder. See Poa Annuus, &c.

Catchweed, or what in different ftations is called goose- grasfs, cleavers, harif, &c. is sometimes a troubuleome gar- den weef, but it is more common in the hedges. This is a weef that may be readily deftroyed in garden-grounds, by pulling it up before the feeds are perfed.

It is fpoken that young geefe are very fond of the tender branches of this weef; and that the feeds of it are capable of being ufed instead of coffee. See Galiwm Aparine.

Garden night-jafted is fpoken to be a common weef in the garden-grounds about Chelsea and Brompton, but which is fpoken found in thofe in the country, though fometimes met with on dung-hills, and other fuch places. See Solanum Nigrum.

Goofefoot, which is a weef of the wild orache defcription, is common and luxuriant in many garden-grounds, being very prolific in feeds, and in the produce of weeds there- from, if not rooted out before the feeds are flattered about on land under cultivation. Thofe, like all other annual feeding feeds, is to be deftroyed only by rooting up before the feeds of it are perfed. See Chenopodium Album, Viride, and Hybridum.

Wild orache, or fat-hen, is a weef nearly allied to the above, and from which it is diftinguifhed only by fome of the flowers having points only, while others on the fame weed-plant have both chives and points, in common with the above fort of weeds. The flowers are small, fo that this diftinction can only be afcertained by the micro- scope. It is a weef which grows much in kitchen-gardens, on rubbifh, and on dung-hills; is an hardy annual, very fertile in feeds; and which is to be prevented or deftrroyed in the fame way as the above kinds. See Atriplex Hajaata.

Fools' parsley, or leafer hemlock, is a weef common in gardens, and which, in its early growth, has much refeemblance to parsley, for which it is often miftaken, and which eaten occasionalsicknefs, swelling, and uneafinefs about the stomacn: it fould always be root out of garden-ground, when it is running to feed, as at that time it is eafily known and belfl deftroyed. See Æthusa Cynapium.

Knot-grasfs is a weef that sometimes grows much on the gravel-walks of gardens and pleafure-grounds, trail- ing to a conliderable length in all directions, being very prolific in feeds, which readily take root. It is, therefore, neceffary to root it well up before they become ripe: hogs are
are said to be very fond of eating it. See Polygonum

*Aniculare.*

*Ground-ash* is said to be a very troublesome weed in the garden-grounds in the neighbourhood of London; but which some suppose to be mostly confined to the shade of hedges. It is believed to be perennial in its nature. In order to get rid of it, the best mode is to cut it up on its first appearance. See *Euphorbia Pedicularia.*

Chickweed is a weed that sometimes grows with great rapidity, and in a very luxuriant manner on garden-ground that is much pulverized and reduced by improper cultivation by the spade, and which is much enriched by good manure: it is an annual weed, very productive of seeds, and where it abounds much, it is perhaps improper to give the land or ground a fine culture until it in some measure disappears: swans are extremely fond of this weed, and it is said to be a grateful food for young chickens. See *Alsine Media.*

Black bind-weed in some places is called bear-bind. It is a parasitical weed-plant, often climbing up bean and other garden crops; it is hardly, and extremely prolific in seeds. To keep garden-ground clear of it, the seeds should never be suffered to shed themselves; the seeds contain a white flower, and are said to be good for pigeons, poultry, and small birds of different kinds. See *Polygnum Convolulus.*

Sun *purslane* is an annual weed, said to be not very troublesome or difficult of eradication, yet not uncommon in garden-grounds. See *Euphorbia Helioscopa,* &c.

Red dead nettle, or *Red nettle,* is a weed of the annual kind, according to some, but which others consider as a perennial. It is common in garden-grounds, flowering early, and for the greater part of the year. The seeds should not be suffered to shed or disperse themselves over the ground, but the weeds be cut up as soon as they appear. See *Lamium Purpureum.*

Henbit is an annual garden-weed, that should likewise be weeded out before the feeds of it are perfected and effective. See *Lamium Ampelasia.*

*Nettle hemp* is a weed of the luxuriant, disagreeable, garden kind, that should always be rooted out of the ground, and kept under in time to prevent its future mischief. See *Galennopsis Tetrapuncta.*

Garden *four-thistle* is a common weed of luxuriant growth, doing great injury to the cultivated crops. It is directed that the seeds of this weed should never be suffered to shed and disperse themselves in any situation; for, being furnished with feathers, they fly over a country with the wind, disseminating themselves widely, and vegetate on the frond like, or cultivated ground on which they settle. It is a favourite food with rabbits and hogs. See *Sonchus Oleracea,* and *Thistle.*

Fumitory is a common, though not very injurious or hurtful weed. It is an annual, and may, consequently, be destroyed by preventing its feeding in an effectual manner. See *Fumaria Officinalis.*

Common *thistle* is a disagreeable and troublesome weed; the seeds of which are numerous, and provided with a downy material to carry them any distance before the wind. They should be drawn up by the roots in moist weather with forceps or tongs for the purpose, as they cannot be pulled by the naked hand.

Garden-grounds are always to be kept well freed from weeds of this sort by all proper means. See *Serratula Arvensis,* and *Thistle.*

*Groundsel,* which is another very common and troublesome weed in garden-grounds, and the seeds of which are feathered, as in the former case, being capable of frowning and spreading themselves far and wide, with this farther chance of propagating themselves, that the plant or weed is extremely quick of growth. The eradication of this weed from gardens must consequently require unremitting attention, by cutting up the young plants as soon as they can be discovered, and letting them run to feed as little as possible. See *Senecio Vulgaris.*

*Common nettle* is a weed that generally grows in hedges or other shady places, but which sometimes appears in other places and in garden-grounds; in which case, it must be destroyed by rooting it up in a complete manner. The leaves of this weed, when cut small, may, it is said, be mixed with the food of turkeys, and other poultry, with benefit. See *Urtica Dioica.*

*Milfoil* may be ranked as a garden-weed, and is very common on fruit-trees, and it is said to be very hurtful in preventing their bearing; it should, of course, be pulled off in time, to as to prevent that fort of injury. It is sometimes, too, plucked off as a sheep-food in the winter, in hard frosty seasons. See *Viscum Album.*

*Cultivated early potatoes,* though it cannot be properly ranked as a weed, is often troublesome in gardens. It is said, that however valuable as a crop, it is very apt to retain in the ground, and intrude itself among other after-crops, to their injury, as well as giving a flowery appearance to the culture. As, however, it is now found that the shoots of this root will crop well after being transplanted, it would seem to be the best way to have them taken up from among other crops as they appear, taking the advantage of flowery weather, and putting them into a bed by themselves, where they may succeed some early crop, such as winter greens, spinach, forward cabbage, and such like, by which means other crops may be rendered clean, and these roots be provided without any expense to feed or eat. See *Solanum Tuberosum,* and *Transplanting.*

*Weeds injurious in Tillage and Corn Lands.*—The principal of those weeds which decidedly injure, and injure grounds under the plough are the given below.

*Foy-leaved thistle* is a weed that is said sometimes to abound very much amongst wheat very early in the spring, but that as feeding and leaving the ground early, may perhaps not much injure the crop: the feed is afforded to ripen in twenty-eight days from the first vegetation of it and the springing up of the plant, which mostly appears in the month of March, and often goes forth a plentiful produce of feeds, which will lie in the ground many years, ready to vegetate the next time the land is broken down and pulverized early in the spring; this fort of work should, therefore, in this case, be done in the fallow, where that practice is in use, which would occasion the feeds to vegetate; but in other cases it may be destroyed by being ploughed under before the feeds of it begin to ripen. See *Veronica Hederifolia.*

*Lamb's lettuce,* or corn-fallad, is a weed that has lately been observed to be more frequent in some districts than formerly. It has been found in a hard tilled field in great abundance. It is an annual weed; and, though not very formidable, ought to be removed from tillage-lands, as it takes away a portion of the nourishment belonging to the cultivated crops. This may readily be done by sowing or cutting it up, or turning it under by the plough, where it can be used, before the feeds of it be perfectly formed. See *Valeriana Locusta.*

*Coeb* of tillage-land is the produce of the three grasses already noticed in a familiar title, under the head of garden-weeds, with the addition of the roots of the creeping soft grass,
WEED.

...is said to be the plague of arable cultivation; and that the roots of these weeds are sometimes so interwoven together in the land or soil in ground that has been under hard tillage and bad management, as to form a perfect matting, and to choke the plough: they abound most, it is observed, in light and mixed soils, not infecting strong clays in an equal manner. The arable land squitch-grafs, which is the most general, is, it is said, of the *agrostis* family; but to which particular species or sort that the most complained of by farmers belongs, is not yet well agreed upon. Some refer it to the fine bent, while others assert it to be a variety of the white. And there are others of great authority who think this squitch-graft has never yet been rightly specified or referred. The ear or awn of this graft has, however, been often observed to have the general habit of the *agrostis*; and that it is very probable that more species than one of this genus have the property of running in the roots, and producing couch.

It is noticed, in addition, that the creeping red-stalked bent grafs, and the creeping lees grafs, are common squitch or couch-grafs on strong or cold wet tillage-lands; and that the tall oat-grafs is a very usual squitch-graft, on the light gravelly soils of some neighbourhoods; that its roots are composed of a bunch of bush, which afford shelter to perennial vermin, as already seen; and that it is difficult of eradication, and very pernicious to crops, especially in wet seasons.

The dog-graft couch, which, in the county of Salop, is often termed fowch, is very common everywhere, and well-known to the coot of the farmers.

Withering, after observing that it can only be destroyed by fallowing in a dry sown, lately, that at Naples the roots are collected in quantity, and disposed of in the market to feed hores. The taste is much similar to that of liquorice, dried and ground into meal, which has been made into bread in years of scarcity. They have besides a deterrent quality, and may be useful in the diseased livers of animals.

However, these grafs, though so troublesome and injurious as weeds on arable lands, are yet probably good as affording meadow-herbage, where their roots are not so liable to run or spread themselves as on tillage-land that is loosened, broken, and reduced, by being constantly wrought by the plough, and other tools.

The destruction of weeds of this sort on arable land, is chiefly effected by the free use of the plough, and other suitable implements, when the weather is in a proper state of heat for the purpose: some think the burinels can only be effected by giving an early and complete spring and summer fallow, by repeated ploughings in time of hot weather, with sufficient harrowings between each ploughing, to work out the squitch, and bring it to the top; and that unless the summer prove dry for some length of time, even this will be insufficient; in which case, many active and industrious farmers have it forked together by hand and burnt: others have it collected and carried into heaps to rot; and it is sometimes mixed with quick-lime, and reduced into a sort of compost heap, which is a practice to be much commended, as wholly destroying it, and at the same time converting it to use: it should not, however, be forgot, that the great increafe of the roots of these weeds is occasioned by hard tillage, or bad management, and often by both. In the county of Gloucester, it is said by the writer of the corrected account of the agriculture of that district, to be a most troublesome and almost unconquerable weed on clay-lands, but that on light lands and loams it may be dragged out and snuffhed by hand-picking with tolerable ease; while on the light soils, and particularly in the wet furrows, nothing but repeated ploughings and exposure to the heat of the sun during the fallmer can check the increafe of it; hence, in that county, the vale-lands, after a wet fallmer, are generally sought. A crop of spring-vetches is said to be well suited to sowther and keep it down, and other sowing green crops may be had recourse to in the same intention. See Triticum Repentis, &c. Also Agrostis Stolonifera, Holcus Molis, &c.

*Wild oat*, or *laver*, is a common weed on hard tilled land, and when abundant, very unprofitable and injurious to a crop. It has been observed by Dr. Anderfon, that this weed-plant abounds so much in the corn-fields in most parts of Aberdenfhire, as in many cases to conferite nearly one-half of the bear or fixed barley-crop, which is much grown in that part of the kingdom; it may be destroyed or greatly reduced by the turnip-culture, or by well-managed early fallowing; and prevented by short tillages, and frequent feeding down to grafs. Dr. Withering, and the Flora Rustica, have stated, that the awns of it are used for hygrometers, and the seeds instead of artificial flies in fishing for trout. The author of the Corrected Report of the Agriculture of the County of Gloucester states, that it is the growth of particular districts, and that it cannot be destroyed; that in fields where the greatest care has been taken to hand-pull every stalk, it has appeared in the following year in equal abundance. That in new broken up leys, which have been in turf or sward beyond the memory of man, these weeds often spring up with as much luxuriance as if they were the natural produce of the soil. When the land is planted with beans or peas, hocking will check and reduce them; but when they grow among wheat, it is not easy to dislodge the plants while young; and that in this case, they are left until they are nearly in ear, and are then drawn out by the hand. See *Avena Fava*.

*White dandelion* is a weed not unfrequently found in wheat-crops, though, it is believed, almost always produced from the seed of it sown with that grain, to prevent which, consequently, great attention should be paid to clean seed-wheat, and particularly that it contain none of the seeds of this weed, as it is extremely profligate, very injurious to a crop while growing, and to the value of the produce at market. It is an annual weed, which has never been recollected to have been seen growing, except in a crop, and but rarely there without neifect in the management of the seed grain, and in other ways. See *Lolium Temulentum*.

*Goose-graza*, or *catchweed*, &c. is a weed in tillage-land, the seeds of which are roundish, rough, two from each flower, so large as not at all to be easily separated from the grain in dressing. This weed is not very common in well-managed lands and crops, being more generally restricted to the hedge banks. It is observed, in the Gloucester Corrected Agricultural Survey, to be a troublesome and frequent weed, on all sorts of soils among corn, and which is not easily destroyed, except by much early care and attention. See *Galium aparine*, and *Spurium*.

*Field scabius* is a weed found sometimes in corn-fields, as well as pastures, though not very abundant. See Scabiosa *Arvensis*.

*Parsley* is a diminutive weed of but small account, though sometimes too much abounding in tillage-lands. This weed might probably be weakened and lefened when in too great quantity by pulverifing and reducing the soil well when in fallmer, very early in the spring season, and by ploughing...
ploughing it under in due time, so as to prevent its feeding. See *Aphanes Arvensis*.

*Dodder* is a parasitical weed, that is said not to be uncommon, in some districts, in the corn-lands. This weed has been observed twining round the flanks or stalks of a bean crop in the county of Buckingham, climbing in a spiral direction round them, from which, by means of vessels for the purpose, it draws its nourishment and support, and mufl, consequently, very much fret and injure any plant to which it may attach itself; it is called in different places, as flated by writers on husbandry, beggar's-weed, hell-weed, and devil's guts, names which sufficiently shew in what sort of estimation it is held by farmers. It is an annual weed, and produced from seed, which takes no root in the earth, but in some part of its felter-plant. It is remarked, by the author of the Corrected Report on Agriculture for the County of Gloucester, to be a great enemy to beans, vetches, and some other fuch plants, but is never seen there among wheat, barley, or oat-crops. That as soon as it has fixed itself upon the plant, it separates from the root, and, like other parasitical weeds, draws all its nourishment from the plant it has fixed upon and embraced. Large quantities of beans are, it is said, often ruined completely by it, so as not to carry a single pod; and that no method has yet been discovered to destroy it; for though the root cannot be found, yet it furly returns, it is thought, in some part of the field where it has once begun to grow, whenever the plants on which it feeds, form the crop of the season. Sheep, in some cafes, have been found useful in lefleing it, by feeding upon it and breaking its runners, when they can be turned into the land where it prevails. See *Cuscuta Europaea*.

*Corn bindweed* is another troublesome parasitical weed in arable-land, often growing amongst wheat, and, when abundant, twining round the flanks of the corn, and very much injuring the crop, when the wheat has been laid by heavy rain. It is said not to be fo common in fome of the inland counties, as in fome of those nearer the metropolis, whence they are in the habit of procuring and being supplied with feed-wheat; on which account it has sometimes been feared that it might be introduced more abundantly by fuch means; but as the seeds are small, they may easily be destroyed in cafe of fuch accidents. It is a perennial weed, and much added to running in the root. It has been proved by an experienced writer, that cutting it off, even below the surface of the ground, only tends to spread it farther; it must be reduced and destroyed, if possible, by means of fawing, and using the fame procefs as for couch or sitch. In fome districts this weed is most frequently found in clays and deep loams, in which the roots strike to fown, that even trenching two fpatis and an half deep will not, it is faid, reach their extremities; and that the smallest pit of a root left in the ground will spring and fife to the furface. It entwines round and encangles all plants in fuch manner, as either to bring them to the ground, or check their vegetation, by injuring their furface of the root. See *Convolvulus Arvensis*.

*Wild carrot* is a common and sometimes a troublesome weed, in dry tillage-land. It is a biennial weed-plant, producing in a plentiful manner. Though fome, as Withering, affert that this, in its cultivated state, is the common well-known garden carrot; yet others, as Miller, contend that the wild carrot could never be improved fo as to render the roots in any degree comparable with the cultivated carrot. However this may be, where it is found in quantity, it should be prevented from feeding, in order to reduce it, and bring it properly under, which may be ef-

**WEED.**

*Shepherd's needle*, or beggar's needle, is a weed sometimes abounding in hard tilled land, and the seeds of which are not wholly separifiable from grain in dressing. It is a small annual weed, that produces a plentiful crop of seeds, each being furnished with a spike or beak of from one to two inches long, whence its name of needle. It seldom abounds much in well cultivated and managed land. See *Scandix Peften*.

*Chickweed*, in some cafes, a troublesome weed in a crop on land which has been rendered fine by tillage, and from which it should, therefore, be rooted out. It has been remarked by the Rev. Mr. Shaw, it is said, that this weed is an excellent out-of-door barometer: that when the flower expands boldly and fully, no rain will happen for four hours or upwards; that if it continue in that open state, no rain will disturb the farmer's day; that when it half conceals its miniature flower, the day is generally showery; but that when it entirely fluts up, or veils the white flower with its green mantle, let the traveller put on his great coat, and the ploughman with his befts of draught reit and retire from their labour. In Glouceftershire it is flated that it grows most plentifully on the good and well cultivated lands. It there mats fo closely round the plants, and covers the surface fo completely, as to keep out the influence of the sun and air; and consequently requires to be removed, which is mostly best performed by the hoe. It may be thus kept under, if not wholly removed and destroyed. See *Alsine Media*.

*Curled dock* is a mischievous weed in tillage-land, and should never be suffered on any account to feed its seeds, and spread them on any land, but be rooted up and carried off in time, to prevent injury. In arable ground, the roots are best picked off with care during the time the land is in tillage, as they will otherwise produce vigorous luxuriant plants which will draw much nourishment from the foil, to the great injury of the ground, and of the intended crop. It is a hardy perennial weed, which is very tenacious of growth by its roots, and producing a wonderful increase of seeds: too much caution cannot, therefore, be used to avoid fowing it, nor too much pains be bestowed in its extirpation and destruction. Withering afferts it to be the pest of clover-fields in Norfolk. See *Rumex Crispus*.

*Arfinarts*, or lake weeds, are plants of this kind, sometimes met with on the wetter forts of arable lands. They abound moft in wet fensons, on the heavier and more moift forts of ground; and as being hardy annuals, producing a plentiful supply of feeds, are apt to thaw themselves in the crops of grain. They are weeds which are to be destroyed by proper fowing, by the removing of the wetness of the land, and by the rooting out of the plants in proper time to prevent their feeding. See *Polygonum Persicaria*, and *Pensylvanicum*.

*Knot grafs* is sometimes a tillage-weed; trailing in its habit of growth; flourishing most by the way-sides: when out of the smothering crops, it is very prolific in feeds. It should be got under by preventing its feeding, by rooting it out sufficiently early for the purpose. See *Polygonum Aviculare*.

*Bears-fruit*, or black bindweed, is a parasitical weed that twines round any thing it can lay hold of, and which is sometimes found among field crops, to their great injury. It is very productive of seeds, which, being angular, are not easily separifiable from grain in dressing and winnowing it. It is nearly allied, it is faid, to buck-wheat, and to which it is preferred by Dr. Withering, who afferts that the seeds
are quite as good for use as those of that wheat, are produced in greater quantity, and the plant bears cold better. From its twining hurtful nature, when among crops, it should be early destroyed, and prevented from feeding and multiplying itself. See Polygonum Convulvulus, and Sagopyrum.

Knautia is a diminutive weed, but prolific in seeds, and of vigorous growth; it is often found on pieces of poor thin soil, when in tillage, but is not believed to be very pernicious: it may probably, when necessary, be weakened, reduced, or destroyed, by an early spring working of the land when in fallow. See Scleranthus Annuus, and Perennis.

Bladder campion is a weed that is common in wheat and barley crops, growing in tufts, with many stalks from each root; which, when the cane, should be rooted out by the hand, or other convenient method. It is a perennial weed, and has the habit and property of increasing from the roots. See Cucubalus Behen.

Cockle is a luxuriant, vigorous, annual weed; perfecting many seeds, and drawing much from the soil or land: care should, therefore, be taken not to sow the seed of this injurious weed. The seeds are so large, that they cannot all be dressed out from the grain, it is said: the plant should, therefore, be plucked out by hand, before the seeds ripen and shed themselves. It is a common weed among wheat and other crops, in many districts. See Agrostemma Githago.

Red and white campion are weeds of the perennial kind, growing occasionally in hedges, corn-fields, and pastures. When they become abundant and injurious, they may be weakened, reduced, or destroyed, by well-managed fallows, in most cafes. See Lychmis Dioica.

Moule-car is a weed that has somewhat the habit of chickweed, but is of a duller appearance: it is frequent among corn-crops, and in pastures, but perhaps not very injurious to the former. See Cerastium Artemisi.

Corn spurry, or yarr, is a frequent weed in corn-fields, though not very bulky or luxuriant, yet quick and tenacious of growth, and producing seeds in a plentiful manner. Dr. Anderson has stated, that in Aberdeenshire it is a pernicious weed, growing in such abundance among the crops as to choke the grain: it has often been seen so thick, that over a vast extent of surface a pin could not have been put down, without touching a plant of it; and that the farmers there think it indefatigable: and it is added, that whenever any of the land had been poached, by being used as a road, especially in wet weather, none of this weed appeared there: that it was evident that this was occasioned by the clods, thus produced, not giving room for the small seeds to germinate freely; which suggested, that if, therefore, he could contrive to bring the ground into a cloddy state, when tawn, he should be free of the weed for that crop. As a crop of bear or fix-rowed barley in one field was entirely loft, the foil or mould being in a loose, mealy, incoherent flate when tawn; it was resolved to delay ploughing it the next season as long as possible, and to plough it at last when it was very wet. Fortunately it came a violent rain in the beginning of the month of March, and it was ploughed when nearly in the state of a puddle, turning over more like mud than foil or earth: dry weather succeeding, this mud bound, it is said, a little on the surface, and produced a kind of clot; the corn was then tawn; it got a very slight harrowing, barely to cover the seeds, in an imperfect manner, and to leave the field as rough as possible: none of the weed appeared, and the crop at harvest was one of the most luxuriant that had ever been seen by the writer. The success of this cafe is not, however, sufficient to recommend it as a general practice.

It has been suggested, that as small birds are very fond of the seeds of this weed, it is probable that, by the surface of the ground being left undisturbed through the winter, a large portion of the seeds would be picked up and devoured by them. It is believed too, that in all cafes of a stubble very full of small seeds, it is well to defer the ploughing as long as it conveniently can, on this account. In respect to land rendered very fine by tillage, it is well understood, it is said, by the farmers of some districts, as those of Staffordshire, to be a fault, and that it is much better left only knappy, as they call it, that is, in small lumps. This is attained in fallows, by working the land early in summer, and letting it lie to consolidate through the latter part of it; and in the turnip culture, by the treading of sheep and cattle: and it is one great reason, it is supposed, why land should not have too many ploughings, but only a proper number judiciously timed; however, that ploughing in general, particularly of broken land, is much best done when the land is dry.

By some means of this kind, this small weed may be kept under without much difficulty. See Specula Artemisi.

Bafe rocket is a weed of the annual kind, that does not abound very much, though it is met with in some places. It has been observed among corn in the county of Gloucester. See Reseda Lutea.

Dwarf sedge is a weed that is common in corn-fields, and generally in single plants, but is not very injurious to the crops. See Euphorbia Esigina.

Corn-poppys is an annual weed that produces numerous seeds, and is sometimes very abundant in corn-fields, being a pretty sure indication of a light crop. It has been questioned, whether the lightness of the crop be occasioned by the abundance of this weed, or the increase of this weed encouraged by the lightness of the crop; and suggested, that probably both are the cause. In a full crop it is scarcely to be found; its flowers appear in July. In the Corrected Report on Agriculture for the county of Gloucester, it is stated to be common in all light and sandy soils, particularly in the neighbourhood of that town. But that since the practice of hoeing has become more general, this weed has been much diminished in quantity. It abounds much, too, on chalky stone-brae poor foils, in some cafes. And in some parts of Berkshire, it is said, in the account of its agriculture, that the poppy almost conceals the corn, when it is in blossom. It is supposed that it might without doubt be weakened, reduced, or wholly destroyed, in fallows, by promoting an early vegetation in common with other feeding plants. See Papaver Rhoes.

Corn crowfoot is a weed that is sometimes very abundant, and injurious to a wheat-crop, on stony moor land. It is an annual weed of early growth, which can only be brought into a full flate of vegetation in the fallow by an early tillage; otherwise the growth of the seeds is, it is said, def erred to the next spring, to the great injury of the crop. In the Flora Ruffica it is noticed, that in some countries it has the name of hunger-weed, whence it is supposed to indicate a barren soil. The orthography, however, is not, it is said, derived from the nature of the soil, but from the hungry prospect it holds out to the farmer. In the county of Gloucester, it is said to grow most abundantly in stony loamy or clayey foils; and that deep and frequent stirrings with the hoe are to be had recourse to, as the most proper means for reducing it, and keeping it under. See Ranunculus Artemisi.

Nettle, or dead nettle, is a weed that much abounds among
WEED.

among tillage-crops, on some lands, especially in moist
seasos. As the weeds are perennial, and produced both
from seeds and the roots, great pains are necessary to be
used in their extirpation and destruction. These are some-
times different sorts met with among crops. See Lamium
Album, and Purpureum.

Calters' fowt is a weed in tillage-lands, in different di-
tricts. It has been observed not to be uncommon among
the corn-crops in Hampshire, in some fummers. It would
appear too from Withering, that several other species of
this genus are common in corn-fields, which are annauls;
but the nature of them, or how far they are injurious to
cultivated corn-crops, has not yet been determined. See
Antirrhinum Orontium, Elatine, Spurium, Arvensis, and
Minus.

Shepherd's purs, or pouch, which, with some others, are
well-known weeds, are sometimes troublesome on arable land.
They are annuals of early appearance, and continue a
great part of the year. They are to be reduced and destru-
ded by early and well-directed fallowing, or by being root-
up from the ground at an early period. See
Thlaspi Arvensis, Campfera, and Burja Puslors.

Whitlows grafs is faid to be a weed among corn, in some
cakes and forts of land, early in the spring; but how far
injuries is not well ascertained: it fhould, however, when
in quantity, be kept well under. It is but small, though
quick in growth, and exhausted in a short time. See
Draba Verna.

Codded mouse-car is another diminutive weed, that fheas
itself early fometimes among corn in tillage-lands; but
being rapid in its vegetation and decline, is not of much
importance as a weed to farmers.

Smooth and rough-toed and pale-flowered chadlocks, &c.
are weeds that are extremely troublesome and difturring to
farmers on tillage-lands, in some places. The writer of
the paper on weeds alluded to above has flated, that thee
three plants are fometimes condensed together by farmers,
under the general name of chadlock, pronounced in the
district where he lives kedlock, and in some others ketlock,
though they are as diff'nt to the investigating inquirer as
wheat, barley, and oats. That they are all extremely
common, or nearly equally fo, if a large range of country be
examined; though the different sorts are more or lesss
abounding in different places; that in his neighbourhood he
can generally gather the three kinds in the fame field, but
the mussard is much the moft abundant. In the vicinity of
Litchfield, where chadlock is indeed very abundant, it is
almost universally wild rape. Some years ago, the writer
observed, in the common fields of the county of Rutland,
that the whole surface was tinge over with the flowers of
the wild radish. They are all great nuisances, and, when
suffered in abundance to ripen their seeds, moft ofnecessity
draw much from the soil, to the great injury of the crop
among which they are; and that as they are very quick of
growth, and perfect their seeds expeditiously, it is not un-
common for these weeds to fheid their seeds at the rate of
several bushels on the acre; and as it is well known that the
seeds are capable of vegetating, after lying many years in
the ground, it is no wonder they should produce a plentiful
crop; yet, being fimply annuals, they are not difficult of
destruction, if due attention and proper means be used.
In order to deftr oy thefe, as well as all other feeding weeds,
the land in tillage fould, it is thought, be pulverized and
reduced early in the spring by ploughing and harrowing,
after which warm weather and rain will soon caufe all the
seeds that are near the surface to vegetate; they may then
be permitted to grow until they begin to flower, when they
are to be ploughed in, and the land again harrowed; and
the next rain will then caufe moft of the remaining seeds to
fhoot, which are in due time to be ploughed under as be-
fore; and if any fould afterwards appear amongst the
crop, they fhould be hoed or hand-weeded out: by this
means, in one or two tillages, these weeds may be totally
eradicaded; but if they be permitted to fheid their seeds,
their increafe cannot be wondered at, when their prolific
nature is confidered, as well as the extreme hardines of
their feeds. The feeds, when drefled from grain, have, it
is understood, been frequently manufactured into oil.

The weed called charlock, in many places, is faid to be
the moft common of any in the vale of the county of Glou-
celler. It is moft probably the fame with the wild muftard,
just noticed. It is faid, that during the fummer, both on
the falls and in the planted fields, its yellow blooms
predominate over every other plant, and that unlefs de-
stroyed in this flate, leave an immense crop of feeds behind.
In order to check the increafe of this weed, the attentive
farmer fuffers it to come into fflom on the falls, and
then turns it in with the plough. This is not always,
however, effectual; as frequently the plants being merely
moved, but not from the roots, and two or three inches of
the tops left above ground, soon recover the injury they
have fultained, and go on to feed before the next plough-
ing. Women and children fhould, therefore, go over the
ground with the hoe a few days after the ploughing, and
cut up the reviving plants; or lambs fhould be kept on fuch
falls, which are faid to eat off the tops with avidity. In
the planted fields they are hoed and weeded, but as fome
will unavoidably escape, women are put in among the corn,
after it is grown to a confiderable height, to pull out the
weeds in blooms with the hand. Though the farmer will
certainly diminish the quantity, and prevent any new acce-
sion by this attention, yet many years of good fubfandcy
muft elpae, before the ill effeets arifing from the negligence
of former cultivators can be conquered; for the feeds being
ftrongly charged with efential oil, will continue in the
ground for an incalculable length of time unjured; and as
often as the foil is turned up, a quantity of them will be
brought sufficiently within the influence of the atmosphere
to vegetate. In 1804, in the parish of Brockthope, in
the above county, a confiderable portion of the land in
the common field was feen completely covered with this weed,
and the feeds perfetely ripe and scattering on the ground.
The ploughing had been neglected until nearly the autumn,
and as the land was not cropped, the charlock grew in great
abundance, and left more feeds than the good fubfandcy of
half a century will be able to eradicate.

It has been fated, that what is vulgarly called charlock
in the vale of the above diatrict, is in reality the common
wild muftard grown in the north for its flour. That it is
there often collected by the country-people for the fame
purpofe; and before the fimple mode of living among the
ancient farmers fell into difufe, few farm-houfes were with-
out a cannon-ball and bawl, in which the muftard-feeds were
bruised, and the flour faved for the table with the black
hulks unfeparated from it.

The name charlock is not unuflually applied by farmers to
different plants of the weed kind, that are equally noxious
and hurtful in arable lands, and fome of them perhaps more
frequent in fuch situations than fome of the above, fuch as
wild muftard and rape, &c. See Brassica Nepu, Sinapis
Arvensis et Nigra, Raphanus Raphaniftrum, &c.

Wild rocket is a weed found in tillage-lands in some di-
tricts. It is faid, that this weed has made great progres in
the corn-fields in some places, and is confidered as a very
formidable
formidable and hurtful plant of that kind. All the parts of this are considerably acid, and have a rank disagreeable smell; whence it is called by those farmers who have it in their lands flinkeweed. It may, it is suppos'd, doublelets, be reduced and destroyed by the processes already recommended for the destruction of chadlock. See Brassica Orientalis.

Funitory is an annual weed, that is not uncommon or usual in corn-fields, though not very greatly pernicious in them. It should, however, be kept well under where it is in any quantity. See Fumaria Officinalis.

Rift barrows are weeds sometimes met with in tillage-lands. They are chiefly two sorts, the former of which is said not to be uncommon in arable lands, where there are no very desirable plants. It is common in some districts among corn-crops, and an hardy perennial weed. In its destruction, if the root can be got rid of in the fallow, there is little danger, it is said, from the seeds: the roots are sometimes so strong as almost to stop the plough, unless the team be very strong. The latter is frequently met with in some places, but is unknown in some of the midland counties. See Ononis Arvensis, or Spinafo.

Tares, particularly in the wild state, is a weed very injurious to corn-crops. It is said to be a terrible enemy to a wheat-crop, where it abounds in considerable quantity. Withering says, that in wet feasions whole fields of corn have been overpowered and wholly destroyed by it. Care should be taken, that seed-wheat be perfectly free from the seeds of tares; and all land should be to them should be got, if possible, so forward in the fallow, as to bring on the vegetation of this weed previously to the sowing of the wheat: the seeds of this weed are said to be good food for pigeons, poultry, and many other sorts of birds. See Ervum Tetrafermum, and Hirsutum.

Rape, in some cafes, is a very injurious weed in arable land. It should, in all cafes where it prevails much, be prevented from ripening and sowing its seeds, as when this is not the case, the farmer has long to regret the consequence of his neglect. See Cha'dock supra.

Meadow is a weed very troublesome in tillage-land. The writer of the paper already noticed saies, that it is a very injurious corn-weed in many parts of the kingdom. That Miller marks Cambridgeshire, and Gerard, Essex, as abounding in it. That it has been heard of in Bedfordshire, and seen among corn in Gloucestershire and Rutlandshire: that in the latter county, five or six shillings the acre have sometimes been said to be expended in weeding it out, without sufficiently effecting the purpose. According to the Flora Rutilaca, there can be no worse weed among bread corn, for a few of the seeds ground with it spoil the flour, by communicating their peculiar strong taste to it. That it flowers in June and the following month, and the seeds ripen with the corn; and that it is probably capable of propagating itself both by its roots and seeds, but might doublets be much weakened and reduced by proper following: that horees are very fond of it; cows, sheep, and swine, eat it; and bees are very fond of the flowers: it is, therefore, though a corn-weed, a good pasture plant. It is said to be common in the vale part of the county of Gloucester, in the arable lands; and it has been suggested, that if the seeds did not afford an unpleasant taste to the flour of wheat with which it may happen to be mixed, it might probably be cultivated with advantage, as all domestic animals are fond of it in some degree. See Tri'polium Melilotus officinalis.

Sow-thistle is a very common and troublesome weed in tillage-land: it is a perennial, and common among corn-crops in some districts; which, in all cafes, when it happens to be so abundant, should be drawn up by the hand or other proper means before it ripens and spreads its seeds; which, as being furnished with a feathery down, would otherwise fly over the whole country and district, as has already been seen. See Sonchus Arvensis, and Thistle.

Common thistle, cursed thistle, or bow-wort, is, in many cafes, a troublesome and disagreeable weed in and about corn-lands and crops. It is commonly called thistle, growing almost everywhere: when injurious in corn-crops, it may, it is said, be weakened and reduced by good tillage and weeding, but not totally destroyed, in perhaps these or any other ways, otherwise than by universal agreement to root it up, before its seeds ripen and become spread, or by some regulation of police enforcing the same. This formidable weed is produced by its numerous fibrous roots, which are hardy and strictly perennial, and which if separated in parts or pieces in ploughing, digging, or working the land, each part will, when left fresh in the soil, often grow or vegetate, and produce a new plant; and by its still more numerous seeds which are feathered, will fly and be carried to a great distance by the wind; and when it becomes calm allowing upon cultivated land, will there vegetate and rife luxuriantly, so that it would be in vain for any person to attempt clearing his land of this weed, unless his neighbours did the same likewise; however, the roots of this weed may, it is said, be effectually destroyed by a well-managed summer-fallow, as they will not survive repeated ploughings in hot weather; and if due attention were belted to prevent the seeding of the weed, its numbers might be diminished very greatly: it is found very hurtful to all field-crops. Some think it easily conquered, however, by proper management and attention in tillage-lands, and that it may either be drawn by the tool for that purpose, or be cut off deep by the hoe or speed-book.

It is suppos'd, on the authority of the Flora Rutilaca, that the goat and the abs will eat it; that horees will sometimes crop the heads while young and tender; but that no other fort of cattle touch it growing. That when burnt, it is said to yield a very pure vegetable alkali. See Serratula and Thistle.

Spear, bur, or bear thistles, are weeds of a very pernicious nature in corn-lands, in many inances and parts of the kingdom. They are said to be called by the last of these names in Staffordshire, to distinguish them from the above weeds, which are likewise termed thistles. There are several sorts of them, and they often abound about the hedge-sides and borders of corn-fields, whence they should be rooted up after rain as much as possible, before their seeds ripen and are ready to spread, otherwise such seeds are liable to fly all over the country, as has been seen: these are weeds that grow very luxuriantly, drawing much from the ground or soil, when among the crops, as is frequently the case in many places. They should always be drawn out as much as can be done in such cafes in hot weather: they are mostly weeds of the annual or biennial kinds. It is said by Withering, in speaking of the uses of them, that should a heap of clay be thrown up, nothing would grow upon it for several years, did not the seeds of the spear thistle, wafted by the wind, fix and vegetate thereon; that under the shelter of these, other vegetables appear, and the whole foon becomes fertile.

They are never to be trusted among crops, but be kept well cut or pulled up in their early growth. See Carduus Lanata, Cardi'un, and Acanthus. Also Thistle.

Coll's-foot is a weed that is very apt to abound in hard tilled land. It has been said that the only time to destroy this weed, is by cutting it up in the accustomed manner when it begins to throw out its flower, at which time, if so cut, it will
will bleed to death; these months are February and March, at which time all land in fallow, which is subject to this weed, should undoubtedly be ploughed and harrowed down, which would, without doubt, check the growth of, and very much weaken the weed; but when neglected at this period, it will soon afterwards ripen its seeds, which fertilised by nature with feathers, fly all over the country, and establish themselves very quickly on cultivated land, and banks of earth newly thrown up. This weed may, it is said, be considerably weakened by repeated summer ploughing, and be afterwards, for the most part, weeded out by hand, as the ground is thus rendered light. It is a weed which in Gloucestershire is not found, except on soils that are poor in their nature, and subject to moistures. The obvious remedies are consequently fertilisation by manure and the removal of wetness by draining. See Tussilago Farfara.

Groundsel is a mischievous and troublesome disgusting weed, not unfrequently found in fallows, on good free soils rendered fine by cultivation, as its seeds ripen quickly in such cases, and fly over the country with the wind: it is a weed that should be got quit of in time by being pulled out, or turned under by the plough, and the seed of it be by no means permitted to ripen and disperse. See Senecio Vulgaris.

Corn marigold, goulans, goul, or buddle in Norfolk, is an extremely troublesome weed in some soils: it is an annual, producing seeds plentifully, which vegetate wherever the land is cultivated, and very commonly in the crops of corn: it would, without doubt, it is suppos'd, be destroyed, as other annual feeding weeds, by early and complete falling to bring the seeds into vegetation in due time, and afterwards ploughing them under. According to Withering, in Denmark, there is a law to oblige the farmers to root it up: and it is said to be flated in the second volume of the "Statistical Account of Scotland," that the late Sir William Gierlon, of Lag, held gout courts as long as he lived, for the purpose of fining such farmers on whose growing crop three heads or upwards of this weed were found; and it has been observed, that some regulation of police for fining those who harbour weeds, the seeds of which may be blown into their neighbour's grounds, has no injustice in the principle of it.

It is flated in the BerkshireCorrected Report on its Agriculture, that it may be destroyed by the application of chalk as a mure, as well as by extirpation.

On the authority of the Flora Ruffica it is noticed, that if this weed be cut when young in flower, and dried, hofes will eat it. See Chrysanthemum Segetum.

Corn mint is a weed that is said by the writer of the Corrected Report of the Agriculture of the County of Gloucester, to be common on damp soils; and it increases fast by the root, where, for want of frequent ploughing, dragging, and other tillage, it is neglected. See Mentha Arvenfis.

Corn camomile is a weed that is sometimes prevalent in corn-fields: it is very prolific in seeds, which should never be suffered to shed, as in that case it would be multiplied to an almost endless degree. See Anthemis Arvenfis.

Stinking May-weed is a plant of this kind that is common in corn-fields among the crops, but which is often confounded with the above and other weeds of that sort, from which it is to be distinguished by its disagreeable smell: it is very injurious to corn-crops, and should be prevented or destroyed by good following, or by being timely rooted out of the land. The Gloucester Report on its Agriculture states, that mathe or matnorn there often overruns a whole field, particularly when planted with peas, so that only the white blossom of the weed is to be seen. The only chance of destroying this stinking weed is, it is suppos'd, by the drill husbandry, where room is left for the free use of the hoe. In the broadcast mode the weeds must be pulled out by the hand, which is not only tedious, but, in some measure, dangerous, as there is a noxious quality in the plant which is liable to injure the hands of the weeder, if they happen to have froes on them. See Anthemis Cotula and Matricaria Channomilla.

Blue bottle is a weed that is common in corn where the tillage of the land has been imperfect, or too long carried on, and continued without cleaning by means of turnips or fallow: it is an annual weed with a somewhat elegant blue flower. It is very common in the crop-fields of Shropshire and Lancashire, as well as in some other counties. It is said that, in Gloucestershire, blue bonnet, knapweed, or corn flower, is a weed common in some fields, principally where the soil is loamy and mixed with pebbles. It is adviz'd to be extirpated at first by the hoe, and, when grown to blossom, by the hand. See Centauria Cyanus.

Great knapweed is a perennial corn weed, growing in tufts of many stems or flanks from the same root; and which is to be destroyed in the fallow, or by being weeded out of the crop. See Centauria Scabiosa.

Pansy is an annual flower weed that is often found among corn-crops in different districts, where it is produced by seeds that have not been destroyed in the preparation for the corn-crop. It is seldom very hurtful, but when abundant should be weeded out in some way or other. The beauty of the colours of its flowers has gained it a place as an ornamental plant. See Viola Tricolor.

Corn horse-tail is a weed often met with in corn-land, the fertile stem of which appearing early in the spring, with that of colt's-foot, and decaying before the other part of the plant appears. The author of the paper already noticed states, that Loefel says, if ewes in lamb eat it, abortion is the consequence; but it is believed that sheep or cows will not eat it, unless compelled by hunger. It is to be destroyed by the same kind of tillage and extirpation, as that recommended for colt's-foot. In the Gloucester Report on Agriculture, it is flated to be found only on moist soils, and cannot be easily overcome, but by draining and completely removing the wetness. See Equisetum Arvenfis.

Fern is a weed not uncommon in corn-fields on dry sandy land: it is a hardy perennial plant, tenacious of growth, and striking a long tap root into the ground, beneath the reach of the plough, which shoots up vigorously when the sun becomes powerful: it prevails largely and strongly on some deep dry hazel loamy soils. In order to destroy it, after soaking rain, it should be drawn or deeply ploughed up; though, in some cases, it will require much pains and attention to get quit of it, especially on land where it has been establisht for a great length of time. See Pteris Aquilina.

There are different other weeds which are occasionally met with in lands of this sort, but which, as their nature, habits, and effects, have not been well or fully ascertained, they have not been noticed here.

Weeds injurious in Meadow and Pasture Lands.—From its not having yet been fully and exactly decided which are to be considered as noxious and hurtful, and which injurious and useful plants, in the herbage of grass-lands, it may be proper and of utility to consider them under the heads of such as are really found prejudicial in such situations, and such as have not been discovered to be actually so, and the particular qualities of which are not well known.
Of the first sort are those which are described below, on the authority of the writer of the paper on weeds mentioned above, and that of some others.

Cotton graps, hare's-tail, or moss crops, are weeds that grow in bogs or boggy meadows; and with the down of which poor peoplestuff their pillows, and make the wicks of candles. This weed is a certain indication that drainage has been neglected, and that it is of course necessary to be attended to and practiced, in order to restore the meadow or other such land to the proper state for the growth of good herbage. See Eriophorum Vaginatum, and Polyfla- 

Chion.

Hog weed, or cow parsnip, is a weed often found in meadows, but which is too coarse and of too weedy a nature and appearance to be suffered to abound in well cultivated and managed grasf-land, though, it is believed, that cattle will eat it either green or in the state of hay; it is thought that it may probably be weakened or destroyed, by annually cutting up in its early growth. See Heracleum Anth- 

tisalum, and Sphondylium.

The latter is frequently met with, especially in moist meadows in Cheshire.

Wild cicer, or cow-weed, is a common weed in orchards, hedges, meadows, and pastures. Cattle are said to be fond of it in the spring, but it is too coarse to be permitted or encouraged among good herbage of the grasf-kind; and as it flowers, and ripens its seeds before the grasses, it is a bad and improper addition to the grasf-plants of both meadow and pasture lands; it is frequent in the meadows of Cheshire. It has been suggested, that this and the last noticed plant may probably be worthy of a trial in cultivation by themselves, as being of luxuriant growth, they would yield a large produce; their value has not, however, yet been fully ascertained; nor especially in this method of culture and management. See Chenopodium Sylvestre.

Garlick, in the wild state, is a weed that is frequently found in meadows and pasture lands, which is considered as greatly injuring the latter when used for cows. It is said to give a disagreeable flavour to the produce of the dairy, as butter and cheese, but it does not seem that cows much dislike or refuse to eat it. It is supposed, however, that this may probably happen on account of its being so much blended and intermixed with other grasses, that they cannot avoid cropping it a little. This weed is frequent in the cow pastures of some parts of Lancashire, Gloucestershire, and most probably many others. See 

Allium Ampeloprasum.

Ramson is a weed that is found in some meadows and other grasf-lands, but more commonly in the hedges; other plants will not, it is said, flourish near it: cows eat it, but it, like the above weed, gives their milk and its produce a garlic flavour; it should, of course, be weeded out of grasf-lands as soon as discovered and destroyed. See 

Allium Ursinum.

Rushes of different sorts are a sort of weed-plants which are not unfrequently met with in meadows and pastures, especially when of the cold clayey kind, and which are a sure indication that the land, in such cases, wants the superficial wetness removed; which, when it has been effected, always gives way to better herbage, though their extirpa- 

tion and destruction afterwards will be promoted and accelerated by top dressings of ashes and other matters. In the Gloucester Report on its Agriculture, it is stated, that the common rush is an inhabitant of soils that are moist and strong, that it abounds in the furrows of pasture-lands, and on the meets or strips of grasf-land left between the grounds in the vale of that county, as the dividing mark of different properties, and that it is destroyed in the manner above. See Juncus, different sorts. Also Rush.

Docks are weeds that are found in strong four heavy land of the meadow and pasture kind. As these weeds are refused by most sorts of domestic animals, they should be rooted up after rain, and every pains be taken to destroy and remove them from grasf-land, which they injure greatly by their shade, and by causing the herbage about them to become rank. They are said to be eaten only by fallow- 

deer, by which their flourishing in parks and pleasure-grounds is prevented. It is remarked that in Gloucestershire docks are extremely injurious to the herbage of pasture-lands, but that if taken in time they may be easily conquered. If, however, they are permitted to ripen, they leave an immense quantity of seed for future crops; and, that being perennial, the evil is increasing in such a multiplied proportion, as almost to exclude the growth of all other plants. In a large meadow adjoining the county-town, these weeds have matured and shed their seeds, it is said, so often, and for so many years, that, at the time of moving, the whole appears like a crop of docks. Where these weeds are not got up by the roots, it is useful, in some cases, to cut through the stalks under the ground; and to repeat the practice as shoots are again thrown up. See Rumex Crispus, Acetos, Obtusifolius, &c. Also Weeding 

Dock-Spit, &c.

Bifol is a weed that, in some places, occupies large portions or patches in meadows, to the injury and destruc- 

tion of better herbage: it is a perennial, but may without doubt be weakened or destroyed by rooting up repeatedly. The root is one of the strongest vegetable astringents, and may probably be applied to many purposes in the arts with benefit. It is the inhabitant of moist meadows in Cheshire. See Polygonum Bifolata.

Wild campions are weeds often found abundantly in pastures formed from ploughed lands: there are two sorts, as those with white and red flowers. Care should be taken to exterminate them from such pastures by proper following the land when in the broken up state. See Lychins 

Dioica, &c.

Goose-tanf, silver-weed, or feathered cinquefoil, is a weed common in many pastures laid down from the arable state, but generally untouched by cattle: it should therefore be destroyed and got rid of in the tillage stage of the land, and by keeping it free of flagrant wetness. See Potentilla 

Anserina.

Tanf is a weed that is found in Gloucestershire, in some pastures by the side of the Severn, and in a few other places in that county, but not in abundance, as well perhaps as in some others, especially in the northern parts of the kingdom. It is an unpleasant weed, it is said, which should be eradicated by the spade, or some other proper means. See Tanacetum Vulgar.

Pilewort is a weed that flowers very early in the spring, and abounds in shady or moist pasture ground; it some- 

times occupies much room in some meadows, and clakens other plants which grow near it; and not being eaten by cattle, it should certainly be extirpated: nothing discourages its increase more than coal and wood-ashes, the writers of the Flora Rustica suppose. See Ficaria Verna, and Ranunculus Ficaria.

Lousewort, or red-rattle, is a weed found in moist mea- 

dows and pastures, and, it is thought, rarely but where the land is in want of being rendered dry: it is said to be very disagreeable to cattle, and injurious to sheep, giving them the scab, and occasioning them to be overrun with vermin: it is believed, however, that these injuries are principally caused
caused by the unwholesome nature or state of the land on which it grows; it may be destroyed, it is supposed, by removing the wetnefs and top dressing. See *Pedicularis Sylvatica*.

*Yellow rattle* is a weed that is said to grow generally in moist meadows in the county of Gloucefter, and which ripens its seeds, and sheds them before the time of mowing, when the dry hulks make a rattling noise under the fcythe: at this time, it contains no nutritious juice at all, though, when green, oxen and horses will sometimes eat it rather eagerly, and at other times refuse it. Having, however, no defirable quality to recommend its cultivation, and oftentimes overrunning large patches of ground, it should be eradicated and destroyed; and being a biennial, this, it is thought, may easily be done, by grazing the land for three or four years in fuccifion, and taking care that the stalks that are left by the cattle be skimmed off by the fcythe before they are ripe enough to fhed their seeds, or while they are in full bloom. In regard to its removal, it is flated, that a farmer near the northern borders of the fame county, fhewed the writer a flooping piece of grasfs-land which had been overrun with rattle: without any view to the defiction of that he conducted the water of an adjoining stream, as well as he could, over the piece which was not, however, wholly watered; but it proved that on the watered part, the rattle was destroyed, while it continued to grow on the portion which had escaped. No plant is more frequently found mixed with the grasfs in the meadows of Cheffhire than this; but as it has nothing to recommend it, and the farmers dislike it, the removal of it should be effected to make way for better herbage. See *Rhinanthus Criftiagalli*.

*Dyer's-broom* is a weed that is seen very abundant in some paflures on strong and moist land, whence, as it is often troublesome, it fould be grubbed up, and be got quit of. Wood wafen, dyer's-wood, or base broom, grows abundantly, it is faid, in many parts of the vale of Glouceftershire, but generally on dry paflures: it is refufed by no cattle but sheep; yet, being inferior to good grasfs, fhould be rooted out, except in places where, as in the neighbourhood of Britof, it is collected and carried while in full bloom to the manufacturs, who, by boiling and other means, extract a fine yellow colour from it. See *Genista Tinctoria*.

*Reff-harrove*, or commock, is faid to be a weed often found in paflures, where it is eaten by cattle, especially the younger shoots of it; but that it is too coaf and rubbifhly to be fuffered to increafe, and fhould confequently be rooted out or grubbed up as foon as poifible. In Glouceftershire it is faid, too, to be a moft troublesome weed, and a pretty fure proof of want of attention, culture, and manure; as by the two former it may be eafily cleared from arable land, as has been fen, and by well-rooted horfe-dung even paflure-lands may be affifted; but that rather than fuch a digifeting plant fhould continue to grow, where its place might be fupplied with good herbage, neither labour nor expence fhould be fpared. The little advantage it gives to sheep, which will eat the young fhoots before the prickles are formed, is not, it is fupposed, a fufficient inducement in the calculation of a good farmer to leave it undifurbed. In the pafl of Elmore, in that county, there is, it is faid, a paflure-ground almoft covered with it, which lies too far from the farm-house to have manure eafily conveyed to it. In this cafe, the occupier tried the experiment of drawing it out by the roots, but difcontinued it from the idea that it came up with greater strength, and in more abundance the fucceding year. The fact is, that the businefs is but half done, if the roots are not entirely removed, as every broken piece will throw out fhoots; and from long continuance of the plant on the fpot, and the annual shedding of the feed of it, it is probable that a new crop will arife in the following fpriug: but the farmer fhould not be difcouraged, it is faid, on his firft attempt; fince, by continually watching the weeds in their early growth, and cutting them off with the hoe, they would gradually be destroyed; and the process would be much affifted by well dressing the places with rotten horfe-
dung, as fuggfeted above. See *Ononis Spinosa*, and *Arvenfa*.

*Common thifle* is a moft noxious weed among grasfs herbage: it has strong roots which fhoot out in a lateral manner, and is a perennial plant of vigorous growth in some foils. It may be got quit of by cutting it off within the ground, or by being rooted up; for the former fort of work the bell time is when the plants are coming into full bloom, as they then become fooner rotten and destroyed in their hollow root parts; and for the latter in paflure-lands when the ground is well foaked with rain, and they can be drawn eafily. They are fometimes very hurtful to the hay lands in the vicinity of the metropolis, where the management is bad. See *Serratula Arvenfa*, and *Thistle*.

*Rough large thiffles*, or boar-thiffles, are weeds of a very troublesome nature among grasfs-crops, and which are always to be got rid of without delay. They are generally mown or otherwife cut over, but are much better rooted or drawn up. It is remarked by the writer of the Corrected Account of the Agriculture of the County of Gloucefter, that thiffles of all kinds are very unpleafant weeds in grasfs-lands; either when green or dried with the hay, they annoy the cattle in feeding, and confequently fhould never be permitted to grow long on any fuch land; to prevent their growing at all, is, it is thought, perhaps impoffible, but the increafe of them may be checked by early attention: while, however, they are left to be mown with the grasfs, or to remain undifurbed in the highways during the fummer, the feeds will be difperfed by the wind in various directions over the country: until a method be therefore adopted to correct the evil in its infancy, the labour bestowed by good farmers for the extirpation of this weed will not, it is faid, produce a complete effect, although it will prevent the plant from being carried to the mow in a flate of equal maturity with the hay, and its feeds afterwards from being difperfed with the dung in the fields. Was every farmer to do the fame, the encouragement to perfevere in the practice would be powerful; but that it is not probable, that a farmer will expend much in doing what the negligence of a neighbour will render ineffectual. Some of thefe thiffle-weeds are annual, others biennial and perennial; confequently, where the diffinition is not known, the fane method is, it is faid, to cut the root with a paddle, deep in the ground, or to draw up the root; and that this fhould be done for the firft time in the fpring, and again on the lattermarch in autumn. See *Cardus Lanceolatus*, &c. Also *Thistle*.

*Cudweed*, or chaifeweed, is a weed faid not to be uncommon in paflures from arable land. It has been fen abundantly in an upland paflure after harley, where the clover had failed of succcefs; cattle refufe it, but it has been fuppofed to be fuccceful in the bloody flux of cattle and of the human fpecies: it feldom appears much in a grasfs-crop, or especially when the artificial grasfs succeded well. See *Gnaphalium Germanicum*.

*Ox-eye*, white margifol, or great daily, is a weed common in some paflures, and not grateful, but which feldom abounds fo as to be much injurious to the grasfs, and which is eafily drawn out by the hand or other fuch means. See *Chrysan-
themum Leucanthemum*.
Black knapweed is a common and abundant weed in some moist and cold meadows and pastures, where it is a very bad plant, being coarse, hard, and fibrous, seldom touched by cattle, either in the green or dry state, and not extirpated from the ground without much difficulty: it is a perennial weed, which increases much by the root, according to the Flora Rustica. It is supposed that it might probably be much weakened and reduced, and be extirpated by degrees by drawing up after rain. It is flatted too, that in Gloucestershire the common black knap or knob-weed, provincially hard heads, is a vile and worthless weed, which cattle of no kind will touch, in any state; and yet it is suffered, on some pastures, to grow and increase to such a degree, as to exclude the appearance of almost every other plant, and, though ulefuels, is mowed with the other herbages, and preferred for winter fodder. That it is a weed which indicates poor land, though probably, by the use of foaper's ashes, it might be conquered, otherwise the ground should be ploughed up and converted to a better purpose. The writer of this article lately saw it wholly covering a poor pasture field in the north of Lancashire, to the exclusion of all useful herbs. See Centaurea nigra.

Sedge-grasses, various sorts, are weeds that are most common in cold, old, dry, moist clayey lands of the meadow and pasture kind, undrained and unimproved; in which they are found, in some places, to occupy the whole surface: they are extremely hardy, and flourish where scarcely any thing else will grow: seem produced by nature from this principle in her economy, that a bad plant is better than none, for these plants are not eaten by any sort of cattle which can get any thing better; yet, upon getting quit of the superfluous moisture or water, and top-dressing the land, it will commonly give way to a finer and more valuable herbage. See Carex.

They have provincially the titles of hard-grafs, iron-grafs, and carnation-grafs, sometimes applied to them.

Common nettles is a weed sometimes growing in tufts on pasture-land, where it should always be rooted up, as it will prevent the growth of good herbage, and render the grass rank near it; affets are said to be found of it, and cows eat it in the flate of hay. See Urtica dioica.

Moss, various sorts, are weeds that are sometimes said to spread on pasture and other grass lands, and, it is believed, indicate that the herbage is slavering and torpid, and flands in need of a stimulus to quicken its growth. Proper top-dressing should be used, and the wetneds be removed, if necessary. Treading by sheep, and scratching the surface by means of fine-teethed implements, have likewise been found of great utility. See Musci, and Moss.

Such plants as the above must be considered as proper and necessary to be extirpated from grass-lands of moit kinds; but there are various others which are of less importance, and the characters of which are more doubtful, and their use not so well determined and decided upon.

Of this latter sort or clafs, the following may be noticed as being mostly improper in such situations.

Crocus, butter-flower, butter-cup, king-cup, or goldcup, are plants almost everywhere found in meadow and pasture lands. The pile-wort is common in some places, and the yellow flowered sort, it is said, survived, has knotty roots, rises little above the ground, blossoms early in the spring, and is chiefly found in meadows that are rather moist, being eaten only by sheep. The other sorts are common in the meadows and pastures everywhere, being very abundant in the hay grounds near the metropolis. Their good qualities in such lands have been much questioned and disputed by many; but the writer of the paper already noticed is inclined to think favourably of them, especially as promoting the digestion of the live-stock that feed in such pastures; and as not having been discovered to be injurious in such situations by farmers in their long experience. The writer of the Gloucester report, however, states, that the several sorts of crowfoot, provincially termed crazys, which in the spring throw a yellow veil over the meadows, are to be reckoned among the ulefuels weeds, having little to recommend them to notice but their gaudy appearance. That the three latter sorts are acid and biting to the全省, and are therefore rejected by cattle nearly alike. It is indeed said, that the creeping crazy is more mild and palatable to some cattle, though it is supposed that cattle eat it rather from necessity than liking; as from its spreading along the surface, it becomes so matted with the herbage, that it must be taken up, in some degree, with it. The flanks of the two others are left standing when the ground is quite bare about them; yet, when made with the hay, they are said to lose the pungent quality; and the brightnings of the blooom in the rick, is always a sign of the whole having been well harvened.

All the sorts of this tribe of plants, though pleasan to the eye in meadows and pastures, in consequence of their display of yellow flowers, are, it is said in the Berkshire report, injurious to the herbage, and little relished by animals of any kind. Although difficult to be eradicated, some of the larger sorts of them may be reduced greatly by proper care and attention. See Ranunculus ficaria, Balbus, Repens, and Arens.

Wild must is a plant found in moit pastures, and which prevents the coagulation of milk; so that when cows have eaten it, as they are apt to do largely at the end of summer when the pastures get bare, their milk can hardly be made to yield cheese; a circumstance which occasionally puzzles the dairy-maids. It is a plant that should be removed from pastures, and which, it is supposed, may be weakened by effectually removing the wetneds of the land. See Mentha arvensis.

Marfield marigold is a plant that occupies much space, and which is dangerous to cows. It should conseqently be removed from pastures and other grass lands. See Caltha palustris.

Watter hemlock is a plant supposèed poisonous to horses, and should therefore be eradicated from pasture-lands. See Thellandrium Aquaticum.

Watter cowbane, meadow-faffon, and treacle-mustard, are plants in pastures and grass lands, that are said to communicate an unpleasant odour to the milk of cows, and to be sometimes fatal to them. When abundant they ought to be removed from such lands. See Cicuta Virosa, Colchicum autumnale, and Theraps Arvensis.

Mooze-car sertion-gras is a plant that onlly proves fatal to sheep, it is fald, and should of course be extirpated from sheep-lands. See Myosotis Scorpiodes.

Rag-roor is a plant in grass-land which cows and horses refuse, and which they will only eat when very young: it is a plant that is flated, in the Cheshire Report on Agriculture, to be regarded as worse than ulefuels both in meadows and pastures. That it frequents rich soils only; and that the farmer there often exhibits the kiddle-dock, as it is provincially termed, as a proof of the goodneds of his land. That while his vanity is flattered by its presence, he not only neglects to extirpate it, but frequently suffers it to spread over one of his best pieces of land, to the injury of himself and the annoyance of his neighbour. It is said that by mowing it is prevented from propagating its seeds; but that the roots are not destroyed. That this is best effected either
either by eating it down while young with sheep, or pulling it up by the hand. This last should be done when the ground is moist, in order that no considerable fibres may be left or left in the land, as if there are the roots will strike again. See Senecio Jacobea.

Meadow sorrell is a plant common in meadows, and especially where the soil is strong and rather wet: it is a coarle plant that is injurious by its shade, and feeds in good grasslands. See Rumex Acetosa.

Wood or meadow anemone is a plant common in meadows, though disregarded by farmers; the whole plant is said to be acidic. Withering affests, that when sheep that are accustomed to it eat it, it brings on a bloody-flux. See Anemone Nemorosa.

Eye-bright is a plant common in pastures, and refused by cattle in general; consequently occupying the place of a better plant. See Euphrasia Officinalis and Odontites.

Dandelion is a disagreeable plant, though common in grass-lands in malt districts; it is said to be scarcely diuretic, and on that account may probably have a good effect on cattle at first going to grass: it is coarse, but good in hay with grasses. See Leontodon Taraxacum.

Yarrow, and freeze-wort, are plants common in pastures, but indifferent to cattle-flock. The former has been recommended for poor land. The common yarrow has been found plentifully intermixed with the herbage in the vale part of the county of Gloucester, where much fed with herbes. Some have, it is said, supposed, that cattle are not averse to it; but it has been observed, that this weed has remained uneaten until every blade of grass has been cropped close to the ground, and therefore that it should be extirpated by the spade or some other means, such as the three-pronged fork, at the expense of manual labour. See Achillea Millefolium and Parnica.

Orchises of several sorts are plants that are common in most meadows, having broad, entire, spotted leaves in general, and large bunches of pale or purple flowers. They generally remain untouched by moat, or all sorts of cattle-flock. See Orchis Maculata, Bifolia, &c.

Plants of this sort have hitherto been much too little examined and inquired into, in so far as relates to their utility and importance, or the contrary, for the uses of the farmer, to afford any thing satisfactory on the subject; but that a great many such plants should be rooted out of grasslands of different kinds there can be no sort of doubt. This would render the meadows and pastures much better for the purposes of hay, and the pasturing and feeding of live-flock of every sort, and be greatly beneficial to the farmer in many ways.

Weeds injurious in waffle and uninclosed Lands.—It is stated by the writer of the paper on weeds, that those considered as particularly hurtful to such land, are not very numerous; for though many sorts of plants, useful as the food of domestic animals, grow there, yet, as there is no possibility of introducing anything better until such lands are appropriated and improved by cultivation, they can hardly be conceived as noxious, so long as nothing better can be put in their stead. That, as such lands in their present condition are useful only as sheep-walks, or for producing fuel, the bettering of them, in the former respect, is an object deserving of attention, particularly as such amelioration would render them of greater value in case of inclosure, and would much shorten the bufnees of bringing them into the state of improvement. See Waste Land.

The weeds that encumber such lands, and reduce their value as sheep-walks, are considered as of two kinds: the common upland rubbith, and the hog produce of plants: the former smother the land, so as to prevent the growth of better herbage; and the latter are generally hurtful to animals that feed on them, either from their own nature, or because the land on which they grow is uncomfortable for and unwholesome to the health of them, especially to sheep.

Upland weeds are all those that rise in high barren situations, and which chiefly confit of herbas of different sorts: furze or gorse, the petty whit, or hen-gorse, and broom, but which is more commonly met with in neglected dry lands of the arable kind: these should all, it is said, where the ground is of tolerable staple, or depth of mould, be burnt off, or grubbed up, early in the spring; and if the land be afterwards sown with grass-feeds of the hay kind in moist weather, it will much improve the herbage: the fern should also be mown, and carried off in the summer, the value of it as litter being well worth the labour and trouble. See Erica, Ulex Europaeus, Genista Anglica, Spartium Scoparium, and Pteris Aquilina.

Bog weeds are those that arise in swamy places, and are caused by flagrant moisture or waters, being principally cotton grasses, matt-grasses, ruthes of several sorts, red-rattle or loufe-wort, marsh, St. Peter’s-wort, king’s-pear, which having two or more of but little consequence in themselves: they, however, indicate boggy land; and in their company are often found purple-flowered money-wort, fedge grases of several sorts, &c.: all which would give way to better herbage, upon the flagrant wettens of such bogs being removed, which should, it is said, be done by a rate, levied on the inhabitants of the neighbourhood, having right of common upon such watter. See Eriophorum Polystachion and Vaccinium, Nardus Strida, Juncus, Pedicularis Sylvallica, Hypericum Clades, Narthecium Officinale, Anagallis Tenella, and Carex.

The disease, termed the rot, in sheep, which so commonly arises in these situations, has been often attributed by flock-farmers and others to the fun-dew, marsh penny-wort, and common butter-wort; weeds found in such lands; but it is more probably caused by the flat insect known by the name of scale, fucida hepatica, which is not unfrequently met with in such watery grounds, flowering to different parts of the plants, and which has been discovered in the diseased lives and bile ducts of sheep thus affected. See Drosera Anglica, Hydrocotyle Inundata, &c.

The writer just noticed fuggeMENTS, that if the country should not yet be ripe or ready for inclosing all the commons and waffle lands, the improvement of their staple by measures of this kind, by destroying weeds and introducing better herbage, by removing the wetness of the bogs, and destroying the aquatic weeds growing thereon, would better their present state, and improve their value to the public, would render them capable of maintaining a greater number of better sheep, and preferre the stock in better health, as well as render the land more susceptible of a rapid and easy improvement by cultivation, whenever the time may arrive for their inclosure, and for such full amendment of their condition.

Weeds injurious in Hedges and other such Fences.—It is remarked in the paper on weeds and weeding, that all kinds of them are hurtful to young hedges, which constantly require to be well cleaned and freed from them for three or more years after planting, as otherwise the young quick or other plants would be choked and destroyed; and that there are also some kinds of weed-plants which very much injure old full-grown hedge-fences. That many kinds of weeds growing in hedges are a great nuisance if the seeds be suffered to ripen, because such seeds are liable to be carried into cultivated
cultivated land by the wind; that there are some kinds of hedge-weeds, too, which bear the character of being injurious to live-flock; these, if the observation be well founded, ought, it is said, to be well cleared from the hedges that such flock frequent; and that, lastly, the improper species of the vegetable kingdom, composting or growing in hedges, may be termed hedge-weeds, because they prevent the main object and end of such hedges, that of dividing, fencing out, and defending the land in a proper manner.

The most hurtful plants of this sort are,

Catch-weed, or cleavers, a weed that has a tendency to choke and injure young hedges, by means of its numerous creeping and twining rough branches: it should, of course, be well cleared out in due time, before it spreads itself much in the bottom of the fence. See Galium aparine.

Great bind-weed is a plant of this sort that is injurious in some hedges, by twining round the growing quick or other plants, and restricting their growth: its roots should consequently be extirpated from such situations, which may probably be worth collecting for medicinal uses, as the infus- 

fated juice of them compose feammony, a powerful purgative remedy. It is eaten greedily, too, by hogs without injury. See Convolvulus sepium.

Great wild climber is a weed-plant common in hedges, and which, in the chalk counties, is said provincially to be called old man's beard, from the hoary appearance of the plant after flowering, the seeds being furnished with numerous grey hoary tails. It is very injurious to hedge-fences, as the leaf-flats twine about any thing they can lay hold of, and thus support the plant, which is large, luxuriant, and heavy, without any strength to support itself, and by its weight hauling down, obstructing the proper growth, and deforming the fences of this kind. Withering remarks, that the fine hairs that give the cottony appearance are, he apprehends, too short to be employed in manufacture, though, it is probable, they may be used to advantage for the stuffing of chairs. See Clematis vitalba.

Wild hop, ladies' flea, or black bryony, and wild vine or bryony, are all weed-plants common in hedges, where they are supposed to be somewhat injurious to the hedge-fences. They do mischief in these situations, by crowding and smothering up the hedge-plants, and preventing their healthy and vigorous growth, as well as by taking away the proper nourishment from their roots. See Humulus lupulus, Tamus communis, and Bryonia dioica.

There are other spreading, twining, and climbing weed-plants, which are occasionally very injurious and troublesome in hedges; such as the common ivy, which spreads and creeps on the banks, and runs up and winds round the stems of the plants, greatly injuring and impeding their growth and strength; the honey-suckle, which binds itself closely about the flasks and branches of the hedge-woods, doing them much injury in different ways; and the briar, which extends its rampant shoots in various directions, to the great annoyance and mischief of the hedge-plants in many cafes. All these should be eradicated and cleared out from hedges in most cafes, as they constantly tend to weaken and render them in bad condition. See Hedera helix, Lonicera periclymenum, and Rosa canina.

Sow-thistles, large rough thistles, knap-weeds, and ragwort, are weeds that have been already noticed, and are great nuisances in hedges, if their seeds be suffered to ripen in such situations. The common nettle, too, is sometimes found in hedges to their great injury. They should all, therefore, be extirpated and cleared out from hedges in their early growth, to prevent future increase.

In addition to these, the writer of the above paper has given the following, the seeds of which are furnished with feathers too, and they are capable of being carried to a great distance.

Yellow devil's bit, yellow hawk-weed, buffy hawk-weed, and smooth hawk's-beard, are weeds often troublesome in hedges, and which should be kept well weeded out at an early period. See Leontodon autumnale, Lactuca virosa, Hieracium murorum et umbellatum, and Crepis tectorum.

Burdock is a well-known plant of the weed kind, which should not be suffered to perfect its seed in hedges, as it is of very luxuriant growth, and of course very injurious and disagreeable in such situations. Withering affirms, that before the flowers appear, the items, stripped of their rind, may be boiled and eaten as asparagus; and that when raw, they are good with oil and vinegar. See Arctium lappa.

Dog's mercury is a weed laid to be noxious to sheep, and which is very common and abundant in some hedges, appearing very early in the spring, when sheep-food is the most scarce; on which account it is thought still more dangerous, if it be so at all. When in very large quantity it may be hurtful to hedges, and should be kept under. See Mercurialis perennis.

Barberry is a frequent plant in hedges; if found to really pollify a blighting quality, it should be removed from the hedges of corn-fields. See Berberis vulgaris.

It is advised by the author of the above paper, that these, as well as other plants of a similar nature, together with all luxuriant weeds and thieves of the bramble kind, and whatever else grows beyond the bounds of the hedge-fence, should be brushed out of such hedges about the middle of the summer, as it is very often done in some counties, as Staffordshire, for the sake of their ashes, which are worth all the labour and expense incurred in burning them, &c.

Weeds injurious in Woods and Plantations of different Kinds.—The weed-plants which are necessary to be considered under this head, are not very numerous: those which are given below are the chief of such as are peculiar to or commonly found in situations of this nature, where no art has been used. They are the most common herbs and plants which are spontaneously produced in woods and plantations without attending to the timber and underground forests; but many other kinds are to be met with, which are less common, and which have been less noticed and considered.

Enchanters' nightshade is a weed found in the woods of Bedfordshire, and some other counties, and by no means uncommon. See Circaea lutetiana.

Wood-reeb is a weed met with in many woods. See Arundo arenaria.

Woodroffe is a weed common in many woods about Enfield, in Staffordshire and Berkshire. Sometimes very plentiful. See Asperula odorata.

Wild angelica is a weed common both in woods and hedges, in many places. See Angelica sylvestris.

Solomon's seal, or wood lily, is a weed found in woods in many different parts of the kingdom. See Convallaria.

English hyacinth, or harebell, and willow herbs, are weeds in some woods. See Hyacinthus non Scriptus, and Epipodium.

Bilberry is a weed met with in moor woods in many parts of the country. See Vaccinium myrtillus.

Wintergreen is a weed-plant met with in the moor-land woods.
WEED.

woods in Staffordshire, and some other counties. See Pyrola.

Wood-forget is a weed very common in woods. See Oxalis Acetosella.

Wood-surge is a weed frequently met in woods, situated in a clayey soil. Plentifully in Needwood-forest, in Staffordshire. See Euphorbia Amygdaloides.

Rasperry, dewberry, and common bramble, are weeds common in most woods, in some of the forts. See Rubus.

Wild Strawberry is a weed common in some woods. See Fragaria Vesca.

Tormentil is very common as a weed in some woods. See Tormentilla Reptans.

Herb bennet, and wood anemone, are common weeds in such situations. See Geum Urbanum, and Anemone Nemorosa.

Wood crowfoot is a common weed in woods on a clayey soil. See Ranunculus Auricomus.

Sinking Hellebore is a weed in woods, in many parts of the kingdom. See Helleborus Exidus.

Wood sage, botony, hedge-nettle, and baikd bairn, are weeds of the common wood kind. See Teuchrium Scorodonia, Betonica Officinalis, Stachys Sylvatica, and Melittis Melissophyllum.

Cow-grass, or cow-wheat, is very common in many woods, and faid to be an excellent herb-cabbage; but little found in pastures, in any situation. See Melampyrum Pratense.

Fig-wort, and coral-wort, are weeds in some woods. See Crophularia Nodosa, and Dentaria Bulbifera.

Post-overflaging is a luxuriant weed-plant, that has been seen with the from five to six feet long, in a wood in Rutlandshire. See Lathyrus Sylvestris.

Wood-urch, wood-pealing, St. John's wort, shrubby hawk-weed, low-wort, hoary groundsel, golden-rod, butter-fly-orchis, friary-blade, hedge-grasses, and purgure-olive, or purgure-laurel, are all plants of the weed kind in woods in different places. See Vicia Sylvatica, Orobus Sylvatica, Hypericum Perforatum, Hieracium Sabaudum, Serratula Tinctoria, Senecio Crucefolius, Solidago Virgaurea, Orchis Bifolia, Ophrys Ovata, Carex and Daphne Mezereum and Laurolca.

It has been remarked, that as no root of cattle can be properly introduced into these situations, in the early growth of the woods, there appears no particular room for the choice of the under herbage; but all large coarse growing weeds of these and other kinds, should be removed or kept well under, and that briars and brambles, if they appear, should on several accounts be grubbed up and destroyed. Ivy, too, as clapping, confining, fretting, and injuring the plants on which it riles, should be early cleared away to prevent the mischief of its after removal.

It is hardly necessary to observe, as it must be evident, that this account is far from comprehending all the plants which have been considered as weeds by writers, and those engaged in the cultivation of land; as such as are known to be prejudicial or hurtful, in some way or other, to some sorts of cultivation or other, have, for the most part, been only introduced.

Those who may wish for further information on the subject, may consult the paper on weeds, by Mr. Pitt, inserted in the fifth volume of "Communications to the Board of Agriculture," and also the new edition of Miller's Dictionary, by Martyn, in which a very large catalogue of weed-plants is given; as also many of the Corrected Reports on the Agriculture of different Counties.

It is remarked by the writer of the above paper, that the plants we term weeds, considered as respecting mankind, are not totally useful; many of them have valuable medicinal, and, perhaps, other qualities and properties, and some of them may be applied to uses so as to pay something towards the expense of clearing them from the ground: thus, fowl-thistles are good for rabbits or hogs, the hog-weed is useful for either pigs or cattle: hares are said to be fond of young thistles when partially dried, and the seed may be prevented from spreading by gathering the down, which makes good pillows; however, there is some danger in trailing them to this flag of growth, as a high wind would and frequently does disperse them over a whole country, as it has been seen already. Chadlock, when drawn, may be given to cows, who are very fond of it; and it is said in the Oxford Report on Agriculture, that it can be converted into good hay. Further, that nettles, fern, and the more bulky hedge-weeds, may be collected and annually burnt, as has been seen above; their ashes being afterwards formed into balls, which are of considerable value, as being used in composing a ley for scouring and cleaning linen and other cloths.

It is flatted, too, that pigeons are of use in picking up the seeds of many weeds that would otherwise vegetate; and the writer has no doubt but that a prodigious quantity of the seeds of weeds are eaten by different sorts of small birds, particularly of those of most of the lake-weeds, of spurry, and in severe weather, of the different sorts of chadlocks, as well as of many other kinds. But that it has been observed, that bees have not thriven or done so well in this country since the extirpation of weeds has been more attended to, and become more general.

It is noticed, that in Japan, and in China, not a weed, it is said, is to be seen; and that they make use of night-foil only as a manure, partly with the view of preventing any risk of weeds being produced in that way.

In concluding, it may be noticed, too, that the same writer has remarked, that the vegetables we term weeds are more hardly and tenacious of growth than any others; nor can it indeed be otherwise than that those plants, which succeed in spite of opposition, must be of the most hardy kind. But that the production or growth of weeds is equally consistent with the divine goodness with that of the most valuable plant, for myriads of diminutive creatures, enjoying life and animation, are fed and supported by them, and to whom they are a more natural prey than the dietic plants of mankind: and that man, polished by reason, reflection, and intelligence, has powers and abilities to select and cultivate such vegetables as are adapted to his use, and proper for his sustenance, and to destroy and expel others; and thus to appropriate to himself what proportion he may think proper of the earth's surface; which if he should neglect to drefs and cultivate properly, it will, in some degree, revert to its natural state, producing the hardier and more coarse and acrid plants for the sustenance of numberless tribes of insects and other little animals, and for an infinity of other known and unknown uses and purposes; and that indeed were it otherwise, the indolence of the human race might, in some measure, subdue the bounty of providence, and the fertile parts of the surface of the earth, instead of being covered with an universal verdure, would, by inexcusables neglect, be rendered little different to the sterile and barren desert.

Weed, Dyer's. See Dyer's Weed, Baskard Rocket, and Weld.

Weed, Fuller's. See Teazel.

Weed, Hook, in Agriculture, a very useful implement for cutting up thistles, and other strong plants of the same nature;
ture; but as thistles, when cut either at an early period of the season, or before much rain falls, are apt to spring up afresh, and produce four or five items in place of one; they should, perhaps, in every instance, be pulled up by the roots, or, if they be cut, the operation should be done with a chisel within the ground, which is formed with a division in the mouth of it, so as to leave the item part of the plant, and cut it deep down. See Weeding Duck-Spit.

Weed, Scot. See Fucus.

Weed, Silver. See Cinquefoil.

WEEDA, in Geography, a town on the E. coast of the isle of Gilolo. N. lat. 0° 15', E. long. 127° 45'.

WEEDEL, a town of the duchy of Holstein; 7 miles S.S.W. of Pinneburg.

WEEDING, in Agriculture and Gardening, the operation of freeing crops of any kind from noxious weeds. On the indispensible necessity, and great utility of this practice, it is altogether needless to enlarge. See Weed.

There are obviously two different methods to be principally employed in the removal and destruction of weeds; one of which occurs in the preparation of the land, and the other during the growth of the crop. In the former method it is necessary that such weeds as are of the root kind should be distinguished from those of the feeding description, as the destruction and removal of them must be effected in different ways, and upon different principles.

Weeding in garden-grounds is always a business that should be regularly and well performed in both the circumstances above-mentioned. Much may be frequently done in the former case by properly ridging or laying up the ground before the severe winter-seaon sets in, and in reducing and breaking it down in the early spring or other time, for levelling it, and making it ready for putting in the necessary crop, as the root as well as the feeding weeds may be greatly extirpated and destroyed in these different operations; the former affording the ready means of taking out the first fort, and the latter by putting them in the sprouting flate, giving the opportunity of destroying the other. In the latter case, a great deal will be effected by the ready and repeated application of the hoe while the crops are upon the ground; and by good and careful hand-weeding, before the weeds have had time to ripen and shed their seeds.

It has been remarked with great truth, in regard to the extirpation and prevention of garden-weeds, that many will almost constantly appear, from the seeds being brought by the wind; as well as by being introduced by using raw dung, particularly of hogs and horfes, which often contains seeds poifoning their vegetative power, and the litter intermixed therewith not unfrequently containing more; which strongly shew that raw dung is very improper for gardens, though often used, particularly for early and other potatoe-crops, as it caufles much trouble and expence in weeding.

Much labour in weeding must necessarily be faved, too, by drawing up all feeding weeds in time, as they appear, and before they have fown their seeds.

The extirpation and removal of weeds from garden-grounds are somewhat differently effected in various places: in some they principally use the fpade, and the threepronged or fangled fork, for cleaning out root-weeds; but the different kinds of hoes are employed for other purposes, of which the common ones are mostly made ufe of for scuffling over the surface, and thole of the triangular and parallelogramic form, for cutting up weeds, mouliding up and clearing growing plants, and loofening the surface of the ground for promoting the sprouting of any seeds that may be present, and other fuch ufees. With thefe the scuffle or sculler is sometimes had reaconee to for cutting the weeds, and working the surface of the land over in large gardens. In the small planted broad-calt town crops, the weeding can only be well accomplished by performing the work by the hand. See Hoe, Fork, Spade, Scuffle, &c.

In regard to destroying and removing weeds in tillage-lands, it has been well observed by Naiftith, in his "Elements of Agriculture," that when the ground is greatly overrun with weeds, a complete winter and summer follow will, for the most part, be found unavoidable, in order to get entirely quiet of them. Rib-fallowing, before the winter sets in, will, it is laid, prepare the foil for parting freely with the vivacious roots, the ploughing and harrowing requisite to tear them up when the spring drought commences, will pulverize and reduce it, and provoke the dormant and inactive feeds to vegetate with the first moisture; by repeated turnings, during the summer, the greatest part may be made to vegetate, and be destroyed as they rife; and the vivacious roots, which lie beyond the reach of the plough, by being long prevented from exercising their vegetating powers, will be impaired in vigour. When winter-wheat, or any crop which is to fland through that season, is intended to be put in on fuch ground, it would be proper that the feed should be fown in drills, that by stirring the intervals in the enfluing summer, the tendency which moft foils have to condense or confolidate too much when greatly pulverized or reduced in their parts, may be counteracted. If spring-feed be intended, the laft ploughing should be given to the land before the winter's rain commences, and the field be accurately and fully surface or furrow-drained, and laid dry. The influence of the atmosphere during the winter will, by these means, communicate the happy medium of confinement, on which so much depends; and the foil, as soon as it gets dry in the early spring, will be in the best order for the reception of the feed at that time, and the weeds the most fully and effectually destroyed and removed.

But where ground has been under any tolerable management, drill culture will, it is said, for the most part, fuit all the purpoifes of a clean fallow, or be the means of rendering the land wholly free of weeds. In repeatedly turning the intervals, most of the annual weeds may be attacked in the group, and be expeditiously destroyed as often as they spring up; and the roots of the perennial ones be turned up and exoped to the heat and drought, which, it is not altogether extirpated, will have their progress checked and prevented. But the rows should also be hand-weeded, and the hand-hoe will not unfrequently be found an important implement in this work. Drill culture may thus be partially exercised, in this intention, it is thought, everywhere with great advantage, adapting the application to any particular situation or circumstances. For example, where alternate coures of tillage and grafs crops are adopted, in a coure of three years' tillage, the second might always be in the drill manner; or if there were maneure to spare, to keep a field in good condition in tillage-crops for four years, both the second and third might be in the drill method: the first on account of the tough turf or fward; and the laft for the sake of fowing the land down with grafs-feeds would be more convenient in the broad-calt flate; but the weeding in these cases should not be neglected; the larger weeds especially; and all those which are most prevalent, and most productive of feed, should be taken out by hand labour, or some fuch means, when they begin to flower. By such strict care and attention to weeding tillage-land and crops and focking the ground with proper perennial graffes when laid to reft, weeds would at length be fo much subdued, it is suppos'd, as to be feldom injurious to the farmer.
WEEDING.

The writer of the paper on weeding has stated, that it is remarked by the author of the Effays on Rural Affairs, that there is only one mode of extirpating annual weeds, the seeds of which are indestructible; which is to put the ground into such a flate as to induce them to sprout or germinate, and then to destroy the young plants by harrowing them up, or ploughing them under. This, it is believed, is strictly true; but the author of the paper just noticed does not exactly agree with the writer of the effays in the process to be pursued for the purpose; the ground, in this intention, in his opinion, should be ploughed before winter, but not harrowed, it being better to lie rough through that season, so as to have the greatest extent of surface possible exposed to the action and mellowing effects and influence of frosts; that, as soon as it becomes dry, in about March, it should be cropped-ploughed and harrowed well down; many of the seeds and roots will then vegetate, which should in due time be ploughed under, and the land harrowed again, and this sort of process be repeated as often as necessary: this, it is said, is the true use and manner of summer-fallow in this view, which, to have its full and proper effect, should always, it is thought, be attended to early in the season, when the powers of vegetation are the greatest, and the heat of the sun is powerful; as under such circumstances the greater number of weeds will be brought into a state of growth.

It is thought that the great defect in the management of summer-fallows in the intention of destroying weeds would seem to be the neglect of working them early in the season, by which omission the vigorous annual feeding-weeds are not brought into vegetation in due time; as, after which, they will not grow until the spring following, when they appear in such abundance among the wheat or other crop, as sometimes to choke it up: this is the reason, it is said, why the field poppy, the corn-crowfoot, the tare, and many other annual weeds, make such havoc among wheat, when by a proper and judicious early working of the fallow, they might have been brought to exhaust themselves in the following summer: this appears very clear from the effect, for in no wheaten fields, the seeds of these weed plants would often fill the ground with a full crop; but seeds can germinate but once, consequently had this vegetation been brought on in the fallow, and the plants afterwards been ploughed under in due time, none could have appeared in the wheat-crop.

It is supposed, too, that the turnip-culture is peculiarly adapted to the destruction of weeds, as for this sort of crop the ground must of necessity be in early and fine preparation, by which weeds of early growth are conveniently brought into vegetation, and destroyed; and those which remain in the living flate in the soil may be exterminated by hoeing. It has been observed by the writer, that wet weather is as necessary as dry to give a turnip-fallow its whole effect; for without a soaking of rain after the land is properly well pulverized, numbers of the seeds of weeds will not vegetate, but remain and grow amongst the crop; the root-weeds are therefore to be destroyed in dry weather, and the seedlings after rain; and though the land should, after a dry season, be apparently in excellent order for sowing, it will be better to wait the effect of rain, and even give time for the seedlings to vegetate, before the seed for the crop be actually sown.

It is, therefore, suggested, that the destruction of root weeds, and those of the feeding kind, on corn-land, must be effected upon different principles, and in different manners; the former, by working them out of the soil in dry weather only; the latter, by pulverising and reducing the particles of the soil, so as to induce the seed to germinate and spring up fully after rain, and afterwards ploughing under the young plants: also that frequent ploughings and harrowings are necessary, to expel all the seedlings contained in the foil to the powers of vegetation. But it is conceived, that the ploughings and harrowings of fallow ground should not, however, immediately succeed each other; time should be given for the conflagration of the foil, which, after well harrowing, will undergo a slight fermentation, and settle, as it were, into a mafs; after which it will turn up mellow, and the destruction of weeds will go on apace. It is thought, that the frequent ploughings, which have been recommended by some, are not only unnecessary, but injurious. It has always been observed, that one ploughing of a fallow too soon succeeding another has no other effect, when used in this intention, than that of rooting about the clods, and preventing the general effect of conflagration and fermentation in the land. The suffering of the weeds to spread their leaves a little between the several ploughings of a fallow, for this purpose, is not, it is supposed, injurious: care, however, must be taken not to carry this notion too far, particularly in the case of squitch or couch grasses, or so as to suffer any of the quick growing weeds to ripen their seeds, or the luxuriant ones to become too large for being buried with the plough. As these remarks are judicious, and perfectly practical, they deserve the particular attention and consideration of the farmer, wherever the weeding and proper cleaning of his ground is concerned.

It is stated too, that in this view, if a fallow for turnips be cropped-ploughed and harrowed down in the month of March, it will generally lie very well to the beginning of May; and that in general no fallow will want ploughing oftener, in such intention, than once in fix weeks, if sufficient harrowings be given between the ploughings. The particular time most proper for these operations must, however, be determined not by any general rule, but by local circumstances, experience, and observation.

In cases where lands have not undergone proper improvement, or been under a bad state of management, weeds cannot be destroyed without much labour and expence. (See Weed.) But where lands are already improved, and have been for some length of time under a good system of management, the bufiness is in part performed, and the evil much leavened; as in such cases, as well as all others, every rotation or course of cropping should render the land cleaner and freer from weeds, which will certainly be the case, where there is a proper and correct attention bestowed on the bufiness. The means which are necessary to be used in this intention are commonly, it is said, these: complete and well-managed fallows, as above, when fallows are necessary or proper; the use of manures, which are free from the seeds or quick roots of weeds; the careful choice of such seed grain as is clean; the practice of short tillages, or that of not taking too many crops in rotation; the having recourse to attentive weeding and a spirited use of the hoe, in which view the drill husbandry doubtless, if it is supposed, affords superior advantages to the broad-cast, in keeping land clean from weeds; but that land must be well cleaned before the drill husbandry is applicable; the plentiful use of the clean seeds of the best grasses and trefoils at the end of the tillage, in each case; the weeding of the land, when in or at grafts, so as not to suffer the seeds of any noxious or injurious plants to spread themselves; and that when upon again breaking up the land, to purse such a fyltem or plan of cropping as will not increase or encourage weeds. But though much might be said on each of these points, it is thought unnecessary, as the intelligent farmer will readily adopt
adopt every necessary regulation and precaution from his own observation and experience. It will, therefore, only be needful to slightly touch upon the different particulars or objects. As the subject of fallows has been already considered and explained, it is unnecessary to be further noticed in this place. In regard to fold-yard manure, it should always, it is supposed, in this intention, undergo fermentation before it is laid upon the land, sufficient to prevent the future vegetation of any seeds that may be contained in it: but it should like-wise be kept as free as possible from the seeds of weeds; and perhaps it is best laid on grass-land, applying only lime, or other manures certain of being clean, to fallows; or if dung not certainly clean from seeds be laid on fallows, it should be applied on them early enough to give time to have the seeds to vegetate and spend themselves before sowing for the crop. It is said, that every one knows the necessity of clean feed-corn to the producing of a clean crop, but sometimes neglects to apply such knowledge; and indeed clean feed-grain is not always to be procured. If weed-feeds be suspected, they should, as often as possible and practicable, be dressed out before sowing the corn. The weeding of crops is generally imperfectly performed, and is likely to continue so, it is thought, in many places, on account of the difficulty of procuring hands enough for work which is only for temporary in its nature. Thistles are generally only cut off, but they should always, it is said, be drawn up by tongs, or other tools for the purpose, and the other sorts of weeds by the hand. The hoe has yet been only of general use in turnip crops, nor is it likely to extend further, unless the drill husbandry should be more established; nor even, in its present application, can proper hands enough be always, it is said, procured at sufficiently reasonable rates. As much, however, should cautiously be done in all these ways as circumstances will allow. In the laying down of land to grass, the importance of clean grass-feeds is well understood; yet the seeds of docks are not unfrequently sown with clover, and these of other pernicious weed-plants with ray-grasses. In all cases, the utmost attention should be paid to the sowing of clean feed of this small kind. And in the weeding of grass-land, docks and thistles are often mown, or only cut off, but they should always be rooted up; for which purpose, docking irons formed upon sufficiently good principles are mostly had recourse to. They are, it is supposed, ev'ry where well understood, consisting simply of a forked or clefted spike of iron, which is jogged within the clift, and fixed to the end of a wooden lever: this being forced down by the hand or foot, so as to incline the root of a dock, or large thistle, will easily bring it up, particularly after rain; but mowing them off, being done with more expedition, is often practised; and they are sometimes left undisturbed, and suffered to scatter their seeds without any effort being made to prevent it, which is very injurious, and always to be avoided as much as possible. It is stated too, that upon breaking up a turf or sward, it is understood in the writer's neighbourhood, that unless a wheat fallow or a turnip crop compose a part of the tillage, the land will be injured, and rendered fouler, and more addicted to produce weeds: this notion is, it is believed, a just one, though often deviated from in practice, for the sake of present profit, and under the delusive idea of cleaning the land again next tillage. It is, however, well ascertained, that land well cleaned by former good management will better bear this deviation; for the fewer weeds it contains at breaking up, the less will be the increase of them during the tillage or after-culture of the ground.

The writer of the Elements of Agriculture noticed above has observed, that it is not enough to attend to weeding in the time of tillage-culture only: it is proper that grass-fields and lands should likewise be kept free of all noxious, hurtful, and unprofitable herbage. The negligence which may be seen in this respect, in many districts and places, is, it is said, harmful. Pastures and other grass-lands are sometimes so cloe covered with large weeds, that the pasturing animals have scarcely room to pick up a mouthful; and thus the vegetable food and other matters, which should nourish good and wholesome pasture and other grass-land herbage, is confumed by useless weeds. And speaking of different coarse and disgracing weed-plants, such as the dock, ragweed, bur, corn, and low-thistles, and some others, it is remarked, that the two last are of the fort which extend their vivacious roots below the reach of the plough, when the land is in tillage. It is not, it is said, uncommon with those who affect to pay a little more attention than ordinary to their pastures and grass-lands, to cut down these plants in the flower. If this be done in a rainy time, or if such rain falls soon after, the water descending into the fresh cut wound of the stem, debilitates the roots, and discourages the growth of the plants for a time, though they are seldom wholly destroyed by it; but that if such critical rains do not occur, fresh leaves immediately arise to support the roots, and the cutting over has very little or no effect. They should consequently be annually pulled up by the roots as soon as possible, after the flower begins to form and swell itself, taking advantage of the first flower which happens to fall, to soften the ground and make them draw up more freely. By pursuing this practice regularly and steadily for a number of years, the deep lying perennial roots are, it is said, gradually weakened, and fall into decay. Nor is cutting down the ragweed of much avail. Some of the plants die, but many survive, and branch out more copiously the ensuing year. But this plant not being deep-rooted, is easily pulled up when in flower, if the ground be soft at the time. The bur-thistle being a biennial plant, may be killed at any time by cutting it under the first leaves. The common dock is the most troublesome plant in grass-land, especially in clayey soils, where it is always the most frequent. Every bit of its long tap-root left in the ground will continue to vegetate and grow, and at length form a new stem and plant. It should, in all cases, be fully turned out with the dock-iron, in the manner already noticed, as soon as the flowering-stem is formed; and as the plants of this kind rise at two feasons, the pasture or grass fields should be weeded twice in the summer, that no seeds may be allowed to ripen. The roots should be fully exposed to the heat and drought; for if they be in a moist place, they will continue to vegetate on the surface, as they lie and strike out side-roots into the ground. All other obnoxious herbage on pastures and other sorts of grass grounds, and all weeds bearing seeds by the sides of roads, ditches, brooks, and other such places, should be cut down too, when they begin to flower, in order to prevent their increase by their seeds being dispersed over the grass fields and grounds.

The writer of the Gloucestershire Report on Agriculture, in repudiating the practice of confining the businefs of weeding almost solely to the tillage-lands, while the meadows and pastures are almost wholly neglected, and over-run with docks, thistles, nettles, hemlock, and many other such weed-plants, remarks, that it is supposed by the farmers, that the fcythe will be early enough to cut them off: the seeds, however, are generally ripened and dispersed before mowing time; and if not, they are carried with the hay to the stall, and mixed with the dung, or into the pasture
WEEDING.

In practice, which is supposed, of increasing greatly. Besides, the mere cutting off this kind of weeds rather improves than diminishes their growth, by forcing them to throw out new shoots from the roots, and that in greater abundance than before. Thus, a thistle, which rises at first with a single item, if cut off above the surface of the ground, spreads with several lateral branches, and covers a large space of ground. The most likely method of destroying them is to draw them up by the roots, as already seen, which may easily be done when the ground is moist, and is done by those farmers there, it is said, who are anxious for their credit, nice in their herbage, and proud of seeing their pastures rivalling the neatness of a lawn. The negligence, indeed, of a neighbour often operates as a discouragement, and it is an evil not easily to be prevented: it is, however, surprising in another instance, it is said, to observe an almost unanimous encouragement given to the multiplication of noxious weeds. In the highways they are left to grow to maturity, and their feeds are dispersed in immense quantities in every direction, and all over the country, by the wind, or by being carried by birds. Under these circumstances, it is said, to be certainly of little use for one, or even all the occupiers of ground, to clear their lands of weeds, while this plentiful source of them remains un molested. One should suppose, the writer observes, that the evident mischief resulting from this neglect would excite a general combination against these destructive enemies to the interests of agriculture: that, however, not being the case, might it not, it is asked, be convenient to incorporate with the duty of the surveyors, or overlookers of the roads, the businefs of cutting up, and otherwise destroying, such kinds of weeds within their districts or boundaries? Should the fact of the thousand-fold increase of such self-sown feeds be doubted or dispufed, let, it is said, any one but observe a patch on a common, from which the turf, or sward, has been pared, how completely it will be covered with thistles in the following summer; and the arable fields adjoining are not much, where this negligence prevails.

And the writer of the paper on the subject of weeding states, that there is another cause of the increase and propagation of weeds, which may be termed a public cause, and which it is not in the power of any individual to prevent; but which a slovenly, neglectful, or ill-disposed person may promote and increase, and which can only be effectually prevented by a political regulation, and for which, it is believed, no provision has yet been made in our political code: thus are the numbers of vigorous and luxuriant weeds which are suffered to ripen their seeds in our hedges, paturtes, woods, and other lands, and the feeds of which being provided with fathery matters, are dispersed over the whole territory of the kingdom, and propagate themselves far and near, growing in whatever places they alight and settle, and producing a most abundant crop: the most common and pernicious of which are suppos’d to be the different sorts of bow-thistles, bow-worts, common thistles, colt’s-foot, ground-fels, knap-weeds, &c. For as the feeding and scattering of the feeds of all these forts of plants is clearly a public nuisance, and as they are subject to be carried to a great distance by the above means, and to do harm to the lands of all occupiers indiscriminately, they should, it is thought, be under the control of our political regulations. This would be the effectual means of preventing much labour and expense to the farmer and the occupier, in the weeding of different kinds of lands and crops, and at the same time go a great way in rendering the territory of the country ultimately clear of a great proportion of its most noxious and hurtful weeds.

Besides, regulations of the above kind have been applied in different countries and places to weed-plants, which are much less injurious and hurtful than these. See Weed, and the above paper in the fifth volume of Communications to the Board of Agriculture.

In some cases and parts of the country, the weeds in the large heavy tillage-lands are destroyed, by an entire and perfect flummer-fallow every third year, which is an effectual but expensive method of proceeding; but on the strong loams and other heavy soils by good hoeing and hand-weeding the drilled or set crops of beans, peas, and some other kinds. On the sandy and other light loams, by well hoeing and weeding by hand the crops of peas, potatoes, turnips, and some others. As soon as the peas or vares are off the land, the ground is ploughed and well harrowed, and the root-weeds picked or raked together, and burned or otherwise disposed of, as noticed above; which is most repeated after the cross-ploughing and harrowing have been performed. The ground being then in a great measure free from root-weeds, the turnips are sown, and the feed-weeds that may arise destroyed by twice or oftener hand-hoeing and weeding. This fort of practice being repeated or put in execution once in three or four years, is capable of keeping light land tolerably clean and free from weeds. However, in the case of a hot dry summer, it is supposed, the labour and expense of raking, collecting, picking, and burning the weeds, may not unfrequently be faved, and the roots destroyed, by only harrowing them to the surface after every ploughing; and by that means expelling them beyond the heat of the sun’s for a sufficient length of time to kill them, which is sometimes effectually done in the course of a week. Care must, however, always be taken that they are fully and completely destroyed, otherwise much mischief may be the consequence, as they are extremely tenacious of life.

In all cases, where the staple or vegetable mould of the soil is of a sufficient depth to admit of trench-ploughing, that fort of ploughing, with the assistance of heavy rolling, and other proper means, will in some circumstances completely destroy root-weeds. In some cases, it is even more effectual for that purpose, it is said, than any greater number of ploughings, and is an excellent method, where it can be accomplished without turning up a poor barren subsoil. The great utility and importance of it in cleaning garden-grounds have already been seen, and it is supposed to be equally beneficial in destroying weeds, and preserving the soil moist in the most drying weather of the summer season. See Trench-Ploughing, and Trenching. Allo Ridging-up.

The work of weeding in all cases should be begun sufficiently early in the spring, that the weeds may not be in too forward a state, and the businesfs, in whatever way it is undertaken, be effectually and completely performed, without any fort of omission or neglect. In the meadows and pasture-lands it should be equally attended to as in the cornfields, as in all situations weeds are a very great drawback upon the farmer’s profit, and of vail inconvenience in many different ways.

It is presumed by the writer of the paper on weeding, that if the above proposed regulations, precautions, and methods of destroying injurious plants were generally adopted in practice, they would render the British empire as safe from weeds as those of China and Japan.

It may be concluded that, on the whole, by great, unremitting, and proper attention, with some such regulations as the above, to the extermination and destruction of all forts of ulefeul and hurtful weeds in cultivated grounds, and from meadows and paturtes, the growth of injurious and worthless plants may be prevented, and the arable crops be rendered...
Weeding-Clief, in Agriculture, an useful tool with a divided chiefl point for cutting the roots of large weeds within the ground. See Weeding-Hook.

Weeding-Dock-Spit, the tool used in extirpating weeds of the dock, thistle, and other such large kinds which are to be got up by the roots. It is a fort of crow or lever, with a claw at the bottom end of it, a little curved forward, and divided into two flde parts, in somewhat the manner of the thin end of a common hammer used for drawing nails: it has an arm or tread which projects at about eight or ten inches from the lower end, for the foot to rest firmly upon in forcing it into the ground, and at a little distance above it, on the back side, a curve of iron, projecting about three inches; on the upper or top end, a handle is fixed, and fastened as in the common spade: in using it the claw feizes the root of the plant, and, by a gentle prefure of the handle end downwards, in the manner of the lever, easily and readily draws or forces it out of the ground: by means of this simple implement or contrivance, many hundreds of such weed-plants may be eradicated or drawn out in the course of a day. It has sometimes the names of weeding-fpd or spade, and dock-fpd or fpad given it. See Weeding.

Weeding- форет, or Tong, the tool of the npper kind, which is made ufe of for taking up some forts of plants in weeding corn and other crops, such as small thistles of different kinds, small docks, and various other fuch weeds. It feizes them by the mouth part, which is fixed upon them by means of the long handles in using it, and readily forces them up. See Thistle-Drawer.

Weeding-Fork, a strong three-pronged fork of the fork fort employed for working root-weeds in tillage-lands, and forking out the weeds of the fame kind in garden-grounds; in both which cafes it is a very ufeful and effective tool. It is fometimes made with flat prongs, and termed a fpad in plantation-grounds. See Fork.

Weeding-Spin, an implement which is constructed differently to fuit different purpofes, but that which is made with a frame fomewhat like that of the common wheelbarrow, is considered the belt in the county of Kent, where tools of this fort are much ufed in the plantation-grounds for different crops. It is a very ufeful and convenient tool for the purpofe of tearing up weeds on summer-fallows, and in many other cafes. Its cheapnefs too is a great recommendation of it, as it is capable of being well constructed for about two pounds. See Harrow, &c.

Weeding-Spin. See Weeding Dock-Spit supra.

Weeds, in Mining, a term ufed by our English diggers to express any fort of unprofitable fubftance found among the ores of metals. They feem to have borrowed the phrase from the gardeners; and as every thing with them is a weed, except what they have planted, and expect to gather, so every thing is a weed with the miners, except the thing they are looking for. See Digging.

The principal fubftances known in our mines under the name of weeds, are mangan or marcasite; this is of three forts, white, yellow, and green; dace, a kind of glittering talcy fioe, of the talcium kind, which endures the fire, and is of various colours and hardneffes; iron-moulds, or pyrite; caulf, which is brownish and fpongy; and gliffer, which is a fort of tale. Phil. Trans. No 69.

Weeds also denote a peculiar habit, worn by the reliiefs of perfons deceased, by way of mourning. See Mourning.

Weed, Septimana, hebdomada, in Chronology, a division of time, comprising seven days.

The origin of this division of weeks, or of computing time by weeks, is greatly controverted. Some will have it to take its rife from the four quarters or intervals of the moon, between her changes of phases, which, being about seven days distant, gave occasion to the division. Be this as it will, the division is certainly very ancient. The Syrians, Egyptians, and most of the oriental nations, appeared to have used it from all antiquity; though it did not get footing in the West till Christianity brought it in; the Romans reckoned their days not by weeks, but by months; and the ancient Greeks by decades, or tens.

Indeed, the Jews divided their time by weeks, but it was upon a different principle from the other eastern nations. God himself having appointed them to work fix days, and to rest the seventh, in order to keep up the fene and remembrance of the creation; which, being effected in fix days, he termed the seventh.

Some authors will even have the use of weeks, among the other eastern nations, to have proceeded from the Jews; but with little appearance of probability. It is with better reason that others suppose the use of weeks, among the heathens of the Eaft, to be a remain of the tradition of the creation, which they had flill retained with divers others.

This is the opinion of Grotius, De Veritat. Relig. Christ. lib. i., who likewise proves, that not only throughout the Eaft, but even among the Greeks, Italians, Celte, Scævi, and even the Romans themselves, the days were divided into weeks; and that the seventh day was in extraordinary veneration. This appears from Job. adv. Apion II. Philo de Creatione. Clem. Alexand. Strom. lib. v. Though Helmsd. lib. i. cap. 84. Philostratus, lib. iii. cap. 13. Dion. lib. xxxvii. Tibbonis, Lucian, Homer, Callimachus, Eutonius, Herodotus, &c. who mention the septenary division of days as very ancient, suppose it to have been derived from the Egyptians.

The days of the week were denominated by the Jews, from the order of their succedion from the fabbath. Thus, the day next after the fabbath, they called the first of the fabbath; the next, the second of the fabbath; and fo of the reft; except the fith, which they call paraftere, or preparation of the fabbath.

The like method is flill kept up by the Christian Arabs, Persians, Ethiopians, &c. The ancient heathens denominated the days of the week from the seven planets; which names are flill generally retained among the Christians of the Eaft. Thus the firft day was called Sun-day, dies solis; the second Moon-day, dies lune, &c. a practice the more natural on Dion’s principle, who fays, the Egyptians took the division of the week itself from the seven planets.

In effect, the true reafon of thefe denominations feems to be founded in fentroy. For the astrologers distributing the government and direction of all the hours in the week among the seven planets, &c. they gave each day the name of the planet, which, according to their doctrine, prefided over the firft hour thereof; and that, according to the order fpecified above; and which is included in the following technical verfe.

Psfl SIM SUM fequitur, pallida Luna subeft. Wherein, the capital letters SIM SUM, and L, are the initial letters of the planets. So that the order of the planets
planets in the week, bears little relation to that in which they follow in the heavens: the former being founded on an imaginary power each planet has, in its turn, on the first hour of each day.

Dion. Caflius gives another reason of the denomination, fetched from the celestial harmony. For it being observed that the harmony of the diatessaron, which consists in the ratio of 4 to 3, is of great force and effect in music; it was judged meet to proceed directly from Saturn to the Sun; because, according to the old fyttern, there are three planets between Saturn and the Sun, and four from the Sun to the Moon.

Our ancestors the Saxons, before their conversion to the Christian faith, named the seven days of the week from the Sun and Moon and some of their deified heroes, to whom they were peculiarly consecrated, which names we received and still retain: thus Sunday was devoted to the Sun; Monday to the Moon; Tuesday, according to some, to Tuirfo or Tuirfeo, mentioned by Tacitus; but, according to others, to Thyfa or Dyfa, the wife of Thor, and the goddess of justice; or, according to others, to Tyr; Wednesday to Woden, the god of war; Thursday to Thor, who prevailed over the air, and was supposed to govern the winds and clouds; this is the same with Lucan’s Taranis, similar to the Welsh word for thunder; Friday to Friga or Frez, the wife of Thor, and the goddesses of peace and plenty; and Saturday to Seater, called also Orudo, to whom they prayed for protection, freedom, and concord, and for the fruits of the earth. The origin of the last appellation, however, is doubtful; as some have observed, that the name Seater is not mentioned by any writer before Verstegan. See Verstegan’s Reification of decayed Intelligence, p. 68. Junii Etym. Angl. and Mallet’s North. Ant. vol. i. p. 91, &c.

To find the accomplishment of Daniel’s prophecy of the Medias, the destruction, rebuilding, &c. of the temple, chap. ix. ver. 24, &c. the critics generally agree to understand weeks of years, instead of weeks of days.

Accordingly, Dr. Prideaux, fixing the end of these weeks at the death of Christ, in the year of the Julian period 4746, and in the Jewish month Nisan, dates their commencement in the month Nisan, in the year of the Julian period 4256, which was the very year and month in which Ezra had his commission from Artaxerxes Longimanus, king of Persia, for his return to Jerusalem, there to rebuild the church and state of the Jews. And thus he finds, that from the one period to the other, there were exactly 70 weeks of years, or 490 years. Compare, vol. ii. p. 381, &c.

Weeds, Ember. See Ember.

Weeds, Fair of. See Pentecost.

Weed, Passion, or the Holy Week, is the last week in Lent, in which the church celebrates the memory of our Saviour’s death and passion.

This is also sometimes called the great week. Its institution is generally referred, both by Protetants and Papists, to the times of the apostles. All the days of that week were held as fasts: no work was done on them; no justice was distributed; but the prisoners were ordinarily set at liberty, &c. even pleasures, otherwise allowed, were at this time prohibited. The oficum charitatis was now forborn: and divers mortifications practised by all sorts of people, and even the emperors themselves.

Week, Rogation. See Rogation.

Week, Week of a Candle, &c. the cotton match in a candle or lamp. See Candle, Lamp, &c.

Week-End, in Ichthyology, a name given by some to a very delicate fish, caught on the East Indian shores, and called by the Dutch there the uit-vijfch. See Vit-Fijch.

Weekly Markets and Fairs, in Agriculture, are of considerable use and convenience to the farmer and land-owner, as affording the ready means of purchasing, providing, and furnishing them with the different articles they are continually in need of, as well as the various sorts and descriptions of cattle and other live-stock, which are always wanted in such cases; as they are common in most large towns, the former once or oftener in the course of the week, and the latter in some inultances in that time, and at more distant periods. They give the means, too, of readily disposing of all sorts of produce and stock of the farm kind, which is often a very great accommodation and advantage to the farmer and store-master, as is fully seen in the weekly market of Smithfield in the metropolis, as well as in many particular markets and fairs in the country, as at Liverpool, Lancaster, Gartling, and many other towns in the north; and at Uxbridge, Reading, Chelmsford, Petworth, and a variety of other towns in the south. See Owen’s Book of Fairs, &c.

Weeling, Anselm, in Biography, born at Bois-le-Duc in 1657, was an imitator of Godfrey Schalken and Adrian Vanderweit; but particularly of the former; and many of his productions have been taken for pictures by that master. He died in 1749.

Weels, in Geography, a river of Germany, which rises in the duchy of Oldenburg, and joining the Ochte, in the county of Delmenhorst, falls into the Weer, 8 miles N.W. of Bremen.

Ween. See Hwes.

Weeninx, John Baptist, in Biography, an excellent artist, was born at Amsterdam in 1631, the son of John Weeninx, an artist of considerable celebrity. He left his father when he was very young, and was placed by his mother with a bookfeller; but his taste for painting manifesting itself decidedly, he was allowed to indulge it, and was placed as a disciple with John Micker, and afterwards with Ab. Bloemart. He made a rapid progress, and drew with superior power the principal buildings in Amsterdam and its vicinity. Animals, birds, hunting, &c. he was skilled in representing, and he soon began to paint his subjects with success. He left Bloemart, and studied a short time with Mooijart; but when he was 18, he found himself sufficiently established to tryst to himself, and his pictures were favourably received.

A desire to improve led him to Rome, where his talents recommended him to many of the principal personages; among others, the cardinal Pamphili gave him a pension, and honoured him with many commissions; he would, indeed, have retained him at Rome, but the solicitations of his family, and his natural desire of exhibiting his power among his countrymen, induced him to return to Holland, after an absence of four years. On his return, he found abundant admiration and employment, which, indeed, he very well merited, as his extraordinary facility in painting a vast variety of subjects has rarely been equalled. He painted history, portraits, landscapes, sea-ports, animals, and dead-game; but he particularly excelled in Italian sea-ports, enriched with noble architecture, and decorated with figures. There is a very beautiful specimen of his power in the gallery of Cleveland-house, which in Britton’s Catalogue is numbered 243. He unfortunately died very young, in 1666, being only 32 years old.

Weeninx, John, son of Baptist, mentioned above, was born at Amsterdam in 1644, and was instructed in painting by his father until he was 16 years of age, when he
he had the misfortune to lose that able instructor. His
talent was not of so general a nature as that of his father;
but in birds, flowers, animals, and fruit, he has seldom been
surpassed for the boldness, animation, and correctness of
touch, or the brilliancy and clearness of colour, as well as of
chiaro-ocuro. The elector John William invited him to
his court, and many of his most considerable productions
are at the gallery of Dusseldorf. He decorated a hunting
feat of the electors, the chateau of Benberg, with a series
of hunting of the bear and the stag, in which he displayed
his skill and taste with brilliant effect. His smaller works are
exquisitely finished, yet with great breadth, and defervingly
effecued. He died in 1719, at the age of 75.

WEEPER, in Zoology. See Simia Capucina.

WEERING, in Phytology. See Lungs and Tears.

Weeping Rock, in Agriculture. A fort of laminated,
or porous, open rock, through which water passes in a slow,
gradual, weeping manner. Strata of this kind are not
unfrequently very troublesome in the practice of draining.
See Wall-Spring and Spring-Draining.

Weeping-Spring, that fort of discharge of water from
the internal parts of the earth which is produced in a very
slow weeping manner. The draining of springs of this fort
is sometimes not attended with much difficulty, while in
other cafes they are often very troublesome. See Spring
and Spring-Draining.

WEER. See WEIR.

Weerawau, in Geography, a town of Hindoostan,
on the borders of the defert of Cutch; 40 miles W. of
Buddakano.

Weerd, or Weerd, a town of Germany, in the
bishipric of Munster, on the Old Iffel; 40 miles W. of
Munster. N. lat. 51° 52'. E. long. 6° 32'.

Weert, or Wert, a town of France, in the depart-
ment of the Lower Meuse; 10 miles W. of Ruremond.
N. lat. 51° 17'. E. long. 5° 45'.

N. Weert, Nider, a town of France, in the
department of the Lower Meuse; 10 miles S.W. of
Venlo.

Weesdale, a town of the illand of Shetland; 6
miles N.W. of Lerwick.

Weesenstein, or Wessenstein, a town of Sax-
ony, in the margraviate of Meiffen; 5 miles S.W. of
Pirna.

Weever. See WEEVER.

Weever, in Ichthyology, the English name for the fish
called by Willughby and other authors the draco-marinus,
or sea-dragon.

Belon says, that this name is a corruption of the French
la vire, because this fish is capable of living long out of
the water.

Mr. Pennant describes another species, under the name of
the great weever, the draco major, or araneus of Salvian,
which inhabits the sea near Scarborough. Brit. Zool. vol. iii.

p. 171.

Weevil, in Natural History, the name of a small in-
fect which does great damage in magazines of corn, by
eating into the several grains, and destroying their whole
substance.

This creature is somewhat bigger than a large louse, and
is of the scarab or beetle kind, having two pretty, jointed,
tufted horns, and a trunk or piercer, projecting from the
fore part of its head: at the end of this trunk, which is
very long in proportion to its body, there is a for of for-
ces or sharp teeth, with which it gnaws its way into the
heart of the grain, either to seek its food, or to deposit its
eggs there.

By keeping these creatures alive in glass tubes, with a
few grains of wheat, their copulation and manner of gene-
ration have been discovered. The female perforates a
grain of wheat, and in it deposits a single egg, or, at the
utmost, two eggs; and this she does to five or six grains
eyery day, for several days together. These eggs, which
are not larger than a grain of sand, in about a week pro-
duce as odd a sort of white maggot, which wriggles its
body very much about, but is very little able to move from
place to place: this, in about a fortnight, turns to an
aurelia, from which is produced the perfect weevil. This
defructive creature is itself very subject to be destroyed, and
when in the egg or aurelia state, it is very subject to be
eaten by mites. Baker's Microf. p. 221. Leewenhoek,
tom. iv. ep. 76.

It is stated in a series of communications which contain
different interesting particulars, inserted in the appendix to
the Corrected Report on the Agriculture of the County of
Middlesex, that J. L. Banger, etc. of the illand of Ma-
deiia, has found that steaming such grain as is infested with
the weevil has the effect of preserving it. In comparing
the method used by another person with his, on portions of
the same cargo of grain, the quantity or weight was greater
in the latter; but the most essential difference was in the
quality, which in the former was almost unfaeable, while in
the latter, or that of steaming, it was better and sweeter
than when firft received. The produce of grain from the
illand of St. Michael it is found cannot be preserved fo long
a time as that which is imported from any other country,
though the manner of keeping it there, which might throw
some light upon the subject, is not known: of this the
writer has recently obtained sufficient experience, it is faid,
by having ordered a part of a cargo of grain to be placed in
a flore which had lately been used with that island wheat;
and from this caufe, in a very short time, had become badly
infected with the weevil. Another purcaher of a part of
the fame cargo, too, is, from a familiar caufe, a fufferer.
The writer has not, however, much anxiety about it, as
the grain he purcahafd and fleated once on the firft of January,
and again on the firft of June, is now, (the time of writing),
in perfect prefervation, and free from the weevil. The In-
dian corn too, that was purcahafd then in March laft, at
which time it was very full of the infect, is at present free
and perfect, it is faid, without a second heating. It is in-
tended piling it again through the fleam, however, it is faid,
as soon as the apparatus is properly fixed, when no doubt
is made of its keeping through the year. In examining the
particular tendency that the grain lately arrived has to the
generation of the infect, the writer has imagined it in some
measure to proceed from the embargo laid upon American
velfels having obliged the merchants in the different fea-port

to keep their granaries so full as to have heated the grain;
though he has some reafon to think that the months of March
and September are attended with peculiar circumstances re-
fecting the increafe of the weevil.

It is found that by the confumption of one hundred
pounds weight of coals in a kitchen portable fleam appara-
tus, three moys, or twenty-feo English buhels of grain can be
fleated in the common hours of work of one day.

The writer had then lately fleated a granary of fixty
moys, or one thousand four hundred and forty English
buhels, in about three weeks. The wale of grain, not
badly infected with the weevil, is found to be one per
cent, in weight in one month, and the increafe fo rapid, that
if proper precautions be not taken, in lea than fix it will
be rendered totally unfit for ufe; and that in the West
Indies the writer is fatisfaaed from his own experience, that
three months will be equal, in deftruction to the grain, to
WEHAX, I. II., and Stor, two small islands on the E.
side of the Gulf of Bothnia. N. lat. 60° 45'. E. long.
21° 7'.
WEHEN, a town of the principality of Naffau Saar-
bruck Ufinigen; 10 miles N.N.W. of Mentz.
WEHLEN, or Windau, or Wehl-Städel, a town of
Saxony; 5 miles S. of Pirna.
WEHMLAIS, a town of Sweden, in the government
of Abo; 20 miles N. of Abo.
WEHNER, a town of East Frieland; 13 miles S.
of Emden.
WEHR, a river of the duchy of Baden, which runs into
the Rhine, 4 miles W. of Seekingen.
WEHRENDORF, a town of Weilphalia, in the
county of Ravenburg; 5 miles W.S.W. of Vlothow.
WEHERNSEE, a town of the duchy of Stiriia; 6
miles N. of Luttenberg.
WEHRHEIM, a town of Germany, in the principality
of Naffau Dillenburg; 18 miles S.S.W. of Dillenburg.
WEIBSTADT, a town of the duchy of Baden; 28
miles E.S.E. of Manheim. N. lat. 49° 17'. E. long.
8° 59'.
WEICHOLTZHAUSEN, a town of the duchy of
Wurzburg; 6 miles N.N.E. of Schweinfurt.
WEICHSEL. See Vistula.
WEICHSELBURG, a town of Saxony, in the lord-
ship of Schonburg; 14 miles N.N.W. of Waldenburg.
WEICHSELBURG, or Weixelburg, a town of the duchy
of Carniola; 28 miles W. of Landdras. N. lat. 46° 5'. E.
long. 14° 15'.
WEICHSELMUNDE, a fort built to defend the city
of Dantzig, on the Vistula. In 1734 it was taken by the
Russians; 4 miles N. of Dantzig.
WEICHTERSBACH, or Wechterbach, a town of
Germany, in the county of Ichenburg, on the Kinzig; 23
miles E. of Francfort on the Main.
WEICKERSBERG, or Weickersberg, a town of
Austria; 5 miles W. of Effersdor.
WEICKERSHEIM, a town of Germany, in the principality
of Hohenlohe, on the Tauber; 23 miles N.N.E. of
Ohringen. N. lat. 49° 30'. E. long. 9° 58'.
WEIDA, a river of Silefia, which rives on the confines
of Poland, and joins the Oder, near Breifan.
WEIDELBACH, a town of the principality of An-
spach; 5 miles S.W. of Feuchtwang.
WEIDENBERG, a town of Germany, in the principality
of Culmbach; 7 miles E.S.E. of Bayreuth.
WEIDEN, a town of Bavaria, in the principality
of Sulzbach, on the Nab; 17 miles N.E. of Sulzbach. N.
lat. 40° 40'. E. long. 42° 4'.—Alfo, a town of the bishopric
of Danberg; 4 miles E. of Weifmain.
WEIDENBACH, a town of Germany, in the marg-
gravate of Anspach; 5 miles S.S.E. of Anspach.
WEIDENBERG, a town of Germany, in the principality
of Culmbach; 7 miles E.S.E. of Bayreuth. N. lat.
49° 55'. E. long. 11° 46'.
WEIDERAU, a town of Saxony, in the lordship
of Schonburg; 4 miles N.E. of Peinig.
WEIERN, a town of Bavaria; 23 miles S.S.E. of
Munich.
WEIF. See Waif.
WEIGEL, ERHARD, in Biography, a German math-
ematician, was born at Weida, in Nordgrau, in 1625, and
dedicated at Weischedel, whither his parents were obliged to
remove, on account of persecution, when he was three years
old; and afterwards at the Gymnafium of Haile, where he
enjoyed the advantage of being instructed in mathematics by
K k
Bartholomew Schimpfer, a celebrated astronomer. The circumstances of his parents obliging him to return to Wenesfeld, he there pursued his studies under an able tutor. Afterwards, encouraged by Schimpfer, he settled at Halle, where his reputation drew to him many pupils, by whom he was enabled to remove to Leipzic for farther improvement; so that in 1653 he was invited to be professor of mathematics at Jena. By favour of William, duke of Saxony, he was appointed mathematician to the court, and chief director of buildings; and thus the latter years of his life were chiefly employed in travelling. In the progress of his years he made many improvements in globes, and other instruments for facilitating the study of astronomy. This ingenious mathematician died in 1699. For a list of his works, which were many, we refer to his article in Gen. Biog.

WEIGELIA, in Botany, a Japanaee genus, dedicated by Thunberg to the honour of Dr. Christian Ehrenfried Weigel, professor of Chemistry in the university of Griepswald, in Upper Saxony, who published at Berlin, in 1769, when he was only 21 years of age, a Flora Pomeranica-Rugica; but whose fame, as a deep and learned practical botanist, chiefly rests on his Observationes Botanicae, published as an inaugural dissertation, under his presidency, in 1772, in quarto, with three plates. This work, from its rarity, is not so well known as it deserves to be. The author corresponded with Linnaeus, and communicated specimens of his new or doubtful plants. —Thum. Jap. 6. Nov. Gen. 5. Schreb. Gen. 113. Willd. Sp. Pl. v. 1. 826. Mart. Mill. Dict. v. 4. Juff. 421. Lamarec Illutr. t. 105.—Clas and order, Pentandria Monogynia. Nat. Ord. uncertain. Jussieu suspects it may belong to his Apocineae, the Contorte of Linnaeus; an opinion which the inference of the style at the base of the germen seems to favour; but the serrate leaves are a great, perhaps infusable, objection. If we might suppose an error as to the situation of the germen, the genus would readily range itself among Jussieu's Capsifolius; but the second species has more the character of his Bignonia, and renders it probable that Thunberg is merely mistaken in his idea of the simple nature of the germen.

Gen. Ch. Cal. Perianth superior, of five awl-shaped, erect, equal leaves. Cor. of one petal, funnel-shaped; tube the length of the calyx, internally hairy: limb bell-shaped, cloven half way down into five ovate, obtuse, slightly spreading segments. Stam. Filaments five, inserted into the tube, thread-shaped, erect, nearly as long as the corolla; anthers erect, linear, obtuse, cloven at the base. Pist. Germen superior, quadrangular, abrupt, smooth; style from the base of the germen, thread-shaped, rather longer than the corolla; stigma peltate, flat. Fruit unknown. Thunberg supposed there was a solitary naked seed.


1. W. japonica. Selfie-leaved Weigelia. Willd. n. 1. Thum. Jap. 96. t. 16. Tr. of Linn. Soc. v. 2. 331. (Nippon Utugi; Kempt. Am. Exot. 855.)—Leaves sessile, ovato-lanceolate.—Native of hilly situations in Japan, flowering in April and May. The stem is shrubby, with opposite, round, smooth branches, slightly quadrangular when young. Leaves opposite, sessile, pointed, coarsely serrated, an inch, or rather more, in length, veiny, smooth on both sides, except the veins, which are hairy; paler beneath. Flowers axillary, compressed, three-flowered, longer than the leaves, with two awl-shaped bracteas at the base of each partial flabellum, and two more about half way up. Flowers about an inch long, reddish-purple. Thunberg's description, in the Flora Japonica, confounds both species together, and is therefore here necessarily corrected.

2. W. corenesis. Large-flowered Weigelia. Thum. Tr. of Linn. Soc. v. 2. 331. Willd. n. 2. (Korei Utugi; Kempt. Amoen. Exot. 855. 1c. Select. t. 45.)—Leaves sessile, obovate.—Native of Corea, whence Kempter supposes it was brought to Japan. He describes it as a floribus with beautiful flowers, smelling like cloves, and changeable in colour, being snow-white, flesh-coloured, and red, on the same plant. His excellent drawing, among those engraved and distributed through the munificence of Sir Joseph Banks, throws more light upon this species, and indeed upon its genus, than any thing else we have met with. It appears to be a climbing or trailing floribus, with round branches, and opposite flabellum leaves, very like those of the Hydrangea Hortensis in size and figure, being thrice the length of the first species, and obovate with a point. Flowers axillary and terminal, three-flowered, an inch and a half long, with awl-shaped bracteas. Tube of the corolla flender, above half an inch long, twice the length of the calyx; limb bell-shaped, twice the length of its tube, divided half way down into five broad, obtuse, horizontally spreading segments. Stamens projecting beyond the mouth. Anthers incumbent. Stigma large, peltate, flat. Nothing appears respecting the germen, or its situation. We do not clearly understand the second of Kempter's separate figures, which is perhaps an under view of the corolla.

WEIGELS DORF, in Geography, a town of Bohemia, in the circle of Königigratz; 2 miles W. of Trautenau.

WEIGELSHAUSEN, a town of the duchy of Wurzburg; 5 miles W.S.W. of Schwinfurt.

WEIGENHEIM, a town of Germany, in the lordship of Schwarzenburg; 10 miles S.S.W. of Schainfeld.

WEIGERSTORF, a town of Austria; 6 miles S. of Wells.

WEIGH, WAT, or WAY, a weight of cleeve, wool, &c., containing two hundred and fifty-six pounds avoiduous. Of corn, the weigh contains forty bushels; of barley or malt, four quarters.

In some places, as Effex, the weigh of cheefe is three hundred pounds. See Measure.

"Et decimam cæli fui de Herting, prater uman peifam, quæ pertinet ad ecclesiam de A. Mon. Angl." where peif seems to be used for a weigh.

Coke also speaks of weighs of bay-falt.

WEIGH-Beams are fixed-yards for the weighing of goods upon wharfs, &c.

WEIGER, an officer in divers cities, appointed to weigh the commodities bought and sold, in a public balance, &c. These weighers are generally obliged by oath to do justice to both parties; and to keep a register of the things they weigh.

In Amsterdam there are twelve weighers, establisht into a kind of office. As it was formerly allowed them to touch the strings of the balance in weighing, it was easy for them to favour either the buyer or seller, according as the one gave them more money than the other. To prevent which abuse, it was charged upon them, by an ordinance of the burgomasters in 1719, not to touch the balance in any manner whatever.

WEIGHGATT, in Geography, a name given to the strait called WATGATT, (which see,) from the wind which blows through this strait (waikam, to blow,) because a strong S.W. wind blows out of it. It is also called Hendlopen. See Martens's Voyage, p. 27.
WEIGHING, the act of examining a body in the balance, to find its weight.

The distillers in London weigh their vessels when full; and for a half hogshead, which is thirty-one gallons and a half, allow two hundred one quarter and eleven pounds for the eaux and liquor. For a puncheon, they allow fix hundred one quarter and two pounds; for a Canary pipe, eight hundred a half and seventeen pounds.

WEIGHING-Cage, in Agriculture, a sort of machine or contrivance which is made in somewhat the form or manner of an open box or cage, by means of which any small animal, such as a pig, sheep, calf, or any other of a similar kind, may be very easily and expeditiously weighed, and with sufficient accuracy and correctness for the purposes of the farmer, floro-matter, and grazier. It is constructed on the principle of the common fleet-yard. It has a strong wooden frame, on which there are fleet centres, in which the pivots of the lever are hung. Upon the short side of the lever is suspended a cord of rope, surrounded by a strong net-work, in which the animal intended to be weighed is put and secured; the point of fulcrum is connected with the rope, by means of a pair of iron-rods, which at the same time form the head of it. A common scale, in which the weights are to be put, is hung on the longer side of the lever.

See STEEL-YARD.

WEIGHING-Chair, a machine contrived by Santorius, to determine the quantity of matter carried off from the body, and that of food taken at a meal; and to warn the feeder when he had eaten his quantum.

That ingenious author, having observed, with many others, that a great part of our diforders arise from the excess in the quantity of our foods, more than in the quality thereof; as also how much a fixed portion, once well adjusted, would, if kept to regularly, contribute to health; be thought himself of an expedient to that purpose. The result was the weighing-chair: which was a chair fixed at one arm of a sort of balance, whereon a person being seated at meat, as soon as he had ate his allowance, the increase of weight made his seat preponderate: so that, defending to the ground, he left his table, victuals, and all, out of reach.

WEIGHING-HOUSE, a building furnished with a dock, and conveniences for gauging or ascertaining the tonnage of boats that are to be used on a canal.

WEIGHING-Machine for Turnpike Roads, in Mechanics, a machine for weighing heavy bodies, and particularly wheel-carriges. This is commonly done in order to ascertain if a carriage is within the weight allowed by law to be carried by such carriage on the turnpike-roads; a weighing-machine, or weigh-bridge, being fixed at every turnpike-gate. See TURNPIKE.

Formerly immense machines were used for this purpose: the machine was erected in an open building, beneath which the road passed, so that a cart, waggon, or other carriage, could be drawn under it: strong chains were then passed beneath the body of the carriage, to attach it to the extremity of an immense fleet-yard. The fulcrum of the fleet-yard was suspended by a lever, or by pulleys and crane-work, from the top of the building; and when the carriage was properly secured, the fleet-yard was hoisted up by the crane-work, so as to suspend the waggon, and it could then be weighed by applying the sliding-weight of the fleet-yard to different parts of the divided bar. Several curious machines of this kind are described by Leopold, in his Theatrum Staticum, 1724.

This method was tedious and dangerous; but when turnpike-roads became more common, a very superior machine was introduced, and we now find one at almost every turnpike-gate. It is called a weigh-bridge, because the carriage is drawn upon a wooden platform or bridge, which is placed over a pit, made in the line of the road, to contain the machinery. The pit is walked within side, and the platform is exactly fitted to the walls of the pit; but as it does not touch the walls, it is at liberty to move freely up and down. The platform is supportd by levers, placed beneath it, and is exactly level with the surface of the road, so that the carriage is easily drawn on to it. This is done without any difficulty or loss of time, because the platform is in the direct line of the road, and the carriage is only required to stop for a minute whilst its wheels stand fairly upon the platform, and the horses stand upon the solid ground beyond the platform. A few small weights put into a scale, like that of a common balance, determine the weight of the carriage and its load. If the weight of the carriage is previously known, the weight of the load may be found, by deducting the weight of the carriage from the total.

This weigh-bridge is placed at the side of a small house, which usually serves as a lodgement for the gate-keeper, and the scale is situated within the house. The platform is supported by two double levers contained in the pit; the ends of these levers are borne up by a long horizontal lever, which passes through one of the side-walls of the pit, and enters into the house: from the end of this lever, a small iron rod is carried up to one end of a common scale-beam or balance, from the other end of which the scale is suspended. All the levers are of the nature of fleet-yards, that is, the weight or load of the bridge is applied upon the levers which support it, at points very near to their respective fulcrums or centres of motion; whilst the ends of these levers are supported, at a very considerable distance from their fulcrums, by the long lever, and they bear upon this lever at a point very near to its fulcrum; but the counterbalancing force, that is, the effort of the weights in the scale, is applied to the extreme end of the long lever, very far distant from the fulcrum. For this reason, a small weight, as one pound for instance, placed in the scale, will bear up a large weight, for instance, 60 pounds, or one hundred weight placed upon the platform, according as the machine is constructed.

This has an advantage, besides the convenience of small weights, viz. that the platform with the carriage does not sink down any perceptible quantity during the action of weighing; for when the weight in the scale is brought to equilibrium with the load, any motion or space which the small weight paffes through, when the scale-beam vibrates, must be to the space which the platform and carriage pass through at the same instant, in the ratio of the load to the weight.

Sometimes, instead of using a scale-board and detached weights, a long fleet-yard is employed, with a weight to slide along upon it to different distances from the centre, until it will counterbalance the load on the platform; in that case, the lever is graduated to shew the weight upon the platform.

Salmon's Patent Weighing Machine.—This is very generally used in the vicinity of London; it points out the weight on a dial.

PLATE II., Engines, contains figures of a weighing machine of the best kind. Fig. 1. is a horizontal plan of the wheels contained in the pit, the platform being taken off to expose them. The under side of the platform is shewn at fig. 2, and fig. 3. is a vertical section of the whole machine.

E E (fig. 3.) is the platform; its upper surface is exactly level with the ground, and the edge of the planking of the platform is fitted into a border or frame which furmounts the side walls of the pit, leaving a small crevice all round its edges, so that the platform does not touch the fixed frame, although...
although it is very near to it. The platform is composed of a strong frame of wood (as shown in fig. 2.), and the upper side is covered with wood planking. It is likewise defended from wear, by iron-bars and large-headed nails, which are fastened on the upper side. Near each of the four angles of the platform a piece of iron is fixed, as shown by \( b \); and it is on these four points that the platform is borne. When the platform is put in its place, these pieces of iron apply to the pins \( bb \) (fig. 1.), which are fixed in four strong iron levers, marked \( AA \), \( BB \). Each of these levers is supported at the extreme end \( c \), on a fulcrum or centre-pin resting on a metal support, as shown in fig. 4., which is borne by a piece of timber \( aa \), worked into the walls of the pit at the angle. At the opposite ends the levers \( AA \) are brought together, and \( BB \) the same, so that all four meet in two points \( a \) and \( b \), and by means of links, shown in fig. 5., are all connected with a long lever \( CC \). This rests on a support or fulcrum \( D \), borne by a pillar erected from the bottom of the pit. The end of the lever at \( I \) is received between two uprights to guide it, but do not any way confine its motion. In the common machine, it is from the extreme end of the lever \( CD \) that the iron rod before mentioned is carried up to the scale-beam, or steel-yard, as before described; but the patent machine in the figure is differently constructed in that part.

The fixed centres \( c \) of the levers \( AA \) and \( BB \), are at the ends of those levers, and the points \( bb \), on which the platform bears, are very near to the centre \( c \); but the distance of the points \( a \) from \( c \) is nine times as great as from \( c \) to \( b \), consequently a force of one pound applied to lift up the levers at the point \( a \) would balance nine pounds laid upon the platform. In like manner the distance from the point \( a \) to the fulcrum \( D \) is only one-seventh of the distance from the fulcrum to the end of the lever \( C \); hence, one pound applied to lift up the end of the lever \( C \) would raise seven pounds applied at the point \( a \), and seven pounds applied at \( a \) would balance sixty-three pounds placed on the platform. To weigh with a machine of this kind, if we use a scale and balance connected with the end of the long lever, we must use weights which are only one sixty-third part of the marks which they bear.

Mr. Salmon's machine operates in a much more perfect manner, by the help of a self-adjusting balance-wheel, which will weigh every different body, without employing any loose weights; and it shews the weight by means of an index and dial, like that of a clock. To effect this, another lever or steel-yard \( FG \) is applied, whereof \( F \) is the fulcrum, and \( G \) the point from which a link \( C \) descends to the end of the long lever \( CD \). At the extreme end \( G \), a trap is attached to ascend to the balance-wheel \( ii \).

Now, as the distance \( FG \) is only one-tenth of the distance \( FG \), one pound applied to lift up the end \( G \) would raise ten pounds at \( f \), or \( 10 \times 63 = 630 \) pounds placed on the platform.

To draw the end \( G \) of the lever upwards, a thin leather trap \( g \) is attached to it, and the upper end of this is covered with a small roller \( b \), which is fixed upon an horizontal axis, as is shown on a larger scale in fig. 7., where the axis is marked \( b b \). This is reduced to small pivots at the extremities, which are borne by friction-wheels \( aa \), to render its motion as free as possible. On the same axis \( b \) is fixed a wheel \( ii \) (see fig. 6.), and again the arms of this wheel a spiral ledge is fixed, with a sufficient projection to admit a fine silk line to wind upon the spiral, when the wheel is turned round. A weight \( k \), which is suspended to the line, forms the counterbalance to the load placed upon the weighing-bridge (see fig. 3.), and the weight of the load is determined by the distance which the roller and wheel \( i \) are turned round. This distance is shewn by an index \( e \) fixed on the extreme end of the axis \( b \), and pointing to different divisions engraved round a dial, as shewn in fig. 6.

This single weight \( k \) can counterbalance all the different weights which may be placed on the platform, because the line by which the weight \( k \) is suspended, when it winds upon the circumference of the spiral, continually applies itself at a different distance from the centre of the axis, so as to operate with greater force. Hence, when any weight is placed upon the platform \( E \), it presses down the levers \( AA \) and \( BB \); these depress the long lever \( CD \), and this again actuates the lever \( FG \), and draws down the trap \( g \), which unwinds from the roller on the axis \( bb \), so as to turn it round, together with the wheel and spiral. The weight \( k \) winds upon the spiral, but the suspending line soon arrives at that part of the spiral where its radius is sufficiently increased, to enable the weight \( k \) to counterbalance the load upon the platform; the balance-wheel being then come to an equilibrium, will move no farther, and the index points out upon the dial the weight of the load upon the platform.

The spiral originates in the central part, at a circle which is of the same diameter as the roller, upon which the trap \( g \) fig. 3., winds; and the weight \( k \) must be equal to the fix-hundred-and-thirtieth part of the weight of the platform and levers \( AA \) and \( BB \), when there is no weight upon it. When the weight \( k \) hangs from this commencement of the spiral, the index \( e \) stands at zero, as shewn in fig. 6. The spiral is so made, that to turn it round sixty degrees will require one ton weight to be laid on the platform, and every additional ton will turn the wheel and index round another sixty degrees, so that the machine will bear five tons before the index makes a complete revolution. Each space of sixty degrees is divided into twenty parts, which represent hundred weights; and each one is subdivided into halves or quarters, which divisions are very apparent on a large dial.

In constructing a machine of this kind, every attention must be paid to accuracy in the centres of motion of the different levers; all these points should be made of steel, and hardened. The form of the centres should be that of a sharp edge, like a blunt knife, with the edge resting on a surface of hard steel, made rather concave (see fig. 4.) Centres, or bearing-points of this kind, made sharp, will move with very little friction; and if the steel is good, and perfectly hard, the edges will not become blunt in many years' use. In all cases, the bearing-pins with the sharp edges must be fixed in the levers; because if the levers were made with plain surfaces, and to have sharp pins to bear upon them, there would be no certainty as to the effective lengths of the different levers, and they would vary in their power whenever the sharp edge changed its place upon the supporting surface.

The four principal levers, \( AA \) and \( BB \), are made double, or with open loops at the ends, as shewn in figs. 1 and 4.; two steel pins are put through the double part, one of them marked \( c \), being made with a sharp edge at the lower side, but the other, \( b \), is sharpened on the upper side. The former bears upon a fixed support faced with hard steel, and the other receives the metal items \( k, g \) fig. 2., which are fixed to the under-side of the platform. The two levers, \( AA \), are joined together at the point \( a \); and the two levers, \( BB \), are also joined in a similar manner. Each pair of levers are connected by a cross-bar, as shewn in fig. 1, so as to make two triangles.

The ends \( a, b \) fig. 5. of the compound levers \( AA \) or \( BB \), where they join together, have a screw fitted through them, as shewn in fig. 5.; the ends of these screws are made of
of steel, and sharp-pointed, in order to rest in a cup or
socket, r, of steel, formed in the lower part of a loop or
link k. The upper end of the loop is suspended upon a
sharp-edged pin fixed in the lever C F, fig. 1, which lever
is marked K and H in fig. 5. The link belonging to the
lever A A is suspended on one end of this pin, and the
other loop upon the other end of the same pin. The lever
C F is made just the same as a common steel-yard.

The spiral, fig. 6, must be made very correctly in brass,
and the line which winds upon it should be very flexible,
and of equal thickness. After every care has been taken
to make all parts of the machine very accurately, they must
be put together and known weights being laid upon the
platform, the divisors on the dial should be laid down from
the positions of the index. If the dial is thus divided by
pure experiment, the machine will weigh very accurately;
but its sensibility will depend upon the sharpness of the cen-
tre of the levers, and the hardness of the steel. When it
is in good order, the addition of a quarter of a hundred
eight to three or four tons, on the weigh-bridge, ought
produce a motion of the index. In an average state
of the machine, it may be depended upon to within half
hundred weight.

Mr. Salmon had a patent for this machine in 1796, but
his invention is confined to the balance-wheel and spiral, as
seen in figs. 6 and 7. These parts, separated from the
great machine, make a very accurate and complete weighing
machine by themselves, when inclosed in a box; a common
dial, to contain the goods which are to be weighed, being
suspended from the lower end of the strap which winds
around the roller.

The introduction of these index weighing-machines for
ramp-roads is of great utility, to diminish thofe inef-}fent
faults between the gate-keeper and the carriers refpe-{ting
the weight of their loads. In the common weighing-
machines, the weights, being loofe and of an arbitrary weight,
may be changed or diminished by the gate-keeper to make
the loads appear greater; and the carrier has no means of
detecting this fraud, except by unloading and weighing his
cargo in small quantities, which is scarcely practicable;
either can he be affairs of the manner of weighing, even
the weights are just. Another source of uncertainty is,
nether the machine be in exact balance when there is no
load on the platform; for as the wood limber and beam
become dirty, it makes considerable variations in the balance
of the machine. To put the machine in equilibrio, a heavy
weight is hung on the end of the lever C D, fig. 3, and can
be placed nearer to or farther from the centre. This should
always be adjusted, but is frequently neglected, and is dif-
ficult of detection.

With the index-machine all these difficulties are avoided:
and is constructed by a maker whose character is at stake,
and when once truly made will continue in the same state,
the whole is locked up, so that the gate-keeper cannot
have access to the index. The only defect arising from age
disuse is, that the index becomes less sensitive, and moves
grittily and by starts. This the carrier can try at any time
by pressing his foot upon the platform; and he can always
by the index returns to zero when the load is removed;
and if it does not, he can see how much the machine is out
d balance.

The law respecting weighing carriages is an inducement
fraud in the gate-keepers; a certain weight is allowed
act of parliament to be carried by each description of
carriage, which weight is regulated according to the width
carriage-wheels, the number of horses, and the season
of the year, whether winter or summer.

If the load does not exceed the allowed weight, a cer-
tain toll is charged for the carriage; but for all excess of
weight, a very heavy toll is charged on each hundred
weight as a penalty, the amount of which is increased
in proportion to the quantity of over-weight. (See TURNPIKE.)

It is a valuable prize for a gate-keeper to find a carriage
overloaded.

WEIGHING-MACHINES FOR SMALL WEIGHTS. These are of
different constructions, according to the use for which they
are intended.

In some the weight of any body is determined by put-
ting loose weights into an opposite scale, and these weights
may be either equal weights to those which they are to
denote, as in the case of a balance with equal arms, or
the weights may be smaller and applied to the longer arm
of an unequal balance, as in the steel-yard. The former is
by far the most accurate, and from the facility of proving
its accuracy by placing the weights in either of the scales,
it has become the legal mode of weighing. Steel-yards are
accurate if carefully used, but afford many opportunities of
fraud in the hands of dishonest persons.

Mr. Medhurst's patent weighing-machine is very useful
in shops and warehouses, being more convenient than the
common balance and scales, and having the same property
of equal arms to the lever. The scale-boards, instead of
being suspended from the arms of the balance, are se-
curedly fixed between the arms of a double balance-beam,
and are placed at such a height as is most convenient to
receive the goods which are to be weighed. The weights are
to be put into the opposite scale, but can be put in either;
and the load on the opposite one, if there is any doubt of the
accuracy of the balance.

When more considerable weights are to be weighed, equal
weights are too inconvenient, that small machines, such as are
used for carriages, are to be preferred for convenience, as
they require only small weights in the scale.

There is another kind of weighing-machines which requires
no loose weights, but shews the weight by a pointer or index
upon a divided arch, or on a dial-plate.

The index and balance-wheel of Mr. Salmon's machine,
when detached, make a very complete weighing instrument
of this kind, as before described.

Other index machines act with a pendulum: thus, the
scale to receive the goods is suspended from a lever, to which
a pendulous arm is attached with a heavy weight at the
extremity to form a pendulum. The application of any weight
in the scale tends to remove the pendulum from its vertical
position; and it is a property of a pendulum to increase in its
effort to return to the perpendicular, in proportion to the
distance by which it is removed from it. The quantity of
variation from the perpendicular is indicated by an index or
pointer to the divisors on an arch, and those divisors are
denoted to the weight. The machine used for weighing hanks of cotton is of this kind, and apothecaries
sometimes use a similar instrument.

Many of the index machines are made with springs, which
are bent by the application of the weight; and the degree
of their flexure, as determined by some indexes, is an indica-
tion of the weight applied. Several machines of this kind
are described in our article DYNAMOMETER; and although
they are rather differently constructed, to fit them for mea-
suring the strength of horses, &c. all of them may be con-
verted to weighing-machines, by applying a proper suspend-
ning hook, with a scale to receive the matter to be weighed.

A curious machine of this kind was made many years
ago by M. Hanin of Paris, and presented to the Society
of Arts. The weight is determined by the degree to which
a feni-
WEI

A semicircular steel spring will be bent, when the weight is applied to force the ends of the spring to recede from each other. The quantity is shown by an index, which turns round over a circular dial-plate, like a clock-hand. The principal curiosity of this machine is, that the dial contains thirteen concentric circles, each divided to show the weight in the denominations of different countries; viz. on the two external circles are divisions to show troy and avoirdupois weight in pounds; within this is a circle to show the corresponding number of Paris livres; next Portuguese arobas, and Spanish arobas; then Dutch, Swedish, Danish, and German pounds; so that the instrument becomes an universal table for the ratios of these different weights.

Weighing-Machine, in Agriculture and Rural Economy, a fort of machine or contrivance made use of for the purpose of weighing neat cattle and some other kinds of animals alive, as well as different other uts. It is a machine which is perfectly simple and easy in its manner of construction. It has a beam of the steel-yard kind, at the top of which is a pin, on which the fulcrum of the beam is made. There is a counterpoise which is moveable along the beam by means of a sliding socket, on which is raised an iron arm, supporting a wooden box or scale to receive the counterbalancing weights in the operation of weighing. There are different levers, which are hung on a projecting pin of the beam by one end, the other resting on an iron support. There is a lid or platform, on which is placed the subject to be weighed; to the under side of this, at each corner, are attached blocks, from which proceed, iron pieces, similar in form to the supporting piece, but reversed in position: by means of these four pieces the lid or platform stands with its whole weight entirely on the lever; other pieces applying themselves to the levers at a small distance nearer to the centre of the machine than to the supporting piece.

In the operation of weighing, the subject to be weighed being placed on the lid or platform, predefined by the different pieces on the levers, which by their fulcement on the beam determine it from its even position by a quantity proportioned to the weight of the subject, which is expressed by the counterbalancing weights required to be placed in the box or scale. See STEEL-TARD.

A machine of this nature is of vast utility and importance in the different systems of grazing, feeding, and fattening various sorts of live-stock and domestic animals, especially where they are carried on to any considerable extent, not only in ascertaining and marking the progress which is made by the different animals, and in discovering how they pay for the use of any particular kind of food, or what power and property it may have in promoting the fattening process, but in many other ways.

Weighing-machines, constructed upon the same plan as those used on the public roads, are applicable, too, in the above cafes, and many others of the rural kind, being ready and convenient for such uses.

Weighing of Air. See Weight of Air.

Weighing Anchor, in Sea Language. See Anchor.

WEIGHT, in Physics, a quality in bodies by which they tend towards the centre of the earth, or in a line perpendicular to its surface. Or, weight may be defined, more generally, a property inherent in all bodies, by which they tend to some common point, called the centre of gravity; and that with a velocity in proportion as they are more or less dense, or as the medium through which they pass is more or less rare.

Weight and gravity are generally considered as one and the same thing. Some philosophers, however, distinguish gravity as the quality inherent in the body, and weight as the same quality exerting itself according to its natural tendency. See GRAVITY, GRAVITATION, and DENSITY.

Sir Isaac Newton demonstrates, 1st. That the weights of all bodies at equal distances from the centre of the earth, are directly proportional to the quantity of matter that each contains; whence it follows, that the weights of bodies have no dependence on their shapes or textures; and that all spaces are not equally full of matter.

2dly, On different parts of the earth's surface, the weight of the same body is different, owing to the spheroidal figure of the earth, which causes the body on the surface to be nearer the centre in going from the equator toward the poles; and the increase in the weight is nearly in proportion to the vered line of double the latitude; or, which is the same thing, to the square of the right line of the latitude; the weight at the equator to that at the pole being as 229 to 250; or, the whole increase of weight from the equator to the pole, is the 25th part of the former.

3dly, That the weights of the same body at different distances above the earth, are inversely as the squares of the distances from the centre, so that a body at the distance of the moon, which is fixy demi-diameters from the earth's centre, would weigh only the 36th part of what it weighs at the earth's surface.

4thly, That at different distances within the earth or below the surface, the weights of the same body are directly as the distances from the earth's centre; so that, at half way toward the centre, a body would weigh but half as much, and at the very centre it would have no weight at all.

5thly, A body immersed in a fluid, which is specifically lighter than itself, loses so much of its weight, as is equal to the weight of a quantity of the fluid of the same bulk with itself. Hence, a body loses more of its weight in a heavier fluid than in a lighter one, and therefore it weighs more in a lighter fluid than in a heavier one.

The foregoing principles laid down by Newton are universally admitted as correct, with the exception of the proportional weight of bodies on different parts of the earth's surface; for it is important to observe, that he founded his calculation of the earth's ellipticity on the hypothesis of its being homogeneous, which is not the case; and hence he makes the equatorial diameter greater than the polar axis, as 250 to 229. But from the numerous experiments since made on the pendulum in different parts of the world, the ellipticity is found to be not so great.

But the investigations on this subject, by the marquis de Laplace, (Mecanique Celeste, vol. ii.) the ellipticity is found to be 1 + 2f, and the calculations and experiments of other astronomers concur nearly in this result, making it on an average about 1.05. In our article STANDARD, we have given tables of these determinations, and likewise of the principal experiments made on the pendulum in different latitudes; and we shall here add some further investigations and new calculations, as essentially connected with our subject WEIGHT, and of peculiar interest at the present time.

The chevalier Delambre, in his "Astronomie," vol. iii. p. 585, gives the following simple and elegant exposition of the pendulum, with other useful formulæ for finding the earth's ellipticity, &c.

Let $h$ be the height of the place of observation above the level of the sea; $R$, the radius of the earth; then the length of the pendulum is to be multiplied by

$$\left(\frac{R + h}{R}\right)^3 = \left(1 + \frac{2h}{R^2}\right) = 1 + \frac{2h}{R^2}.$$

Let
Let \( L \) be the length of the pendulum at the equator; for another latitude, it will be \( L + a \sin^2 H \), so that \( a \) is the excess of the polar pendulum above the equatorial pendulum, \( H \) being the latitude of the place.

Let \( m \) and \( n \) be the two pendulums observed in two very different latitudes.

\[
m = L + a \sin^2 H,
\]
\[
n = L + a \sin^2 H',
\]
\[
m - n = a (\sin^2 H - \sin^2 H') = a \sin (H - H') \sin (H + H')
\]

If there be a greater number of similar equations, put in each the numerical value of \( \sin^2 H \), and determine the two constant quantities, \( L \) and \( a \), by the sum of the observations, employing, if you think proper, the method of the smaller squares.

Now the ellipticity is proved to be \( 0.00865 - \frac{a}{L} \). We have then a value of the ellipticity, which may be compared with that of the degrees. It was in this manner that M. Mathieu found the ellipticity to be \( \frac{1}{298.2} \), by the six actual measurements of the pendulum made on the meridian from Dunkirk to Formentera. So far Delambre.

From the above equations and formula it is manifest, that if \( L \), the length of the equatorial pendulum, and \( a \), the difference between it and the polar pendulum, be known, all other questions connected with the subjeet may be accurately determined; and hence it is, that the important problem of measuring the pendulum has long engaged, and still continues to command the attention of the first astronomers in Europe.

Laplace, in the Mecanique Celeste, gives the following values of \( L \) and \( a \); viz. \( 0.090631131 + 0.0053982 \) fin.\(^2 \) latitude, from which formula the lengths of the pendulum may be computed in all latitudes; but the same learned author has recently published another formula in the Connoissance des Tems (1826, page 442), which is thus given.

"Mathieu, by a new discussion of all the observations of the pendulum, in using the results of Borda's experiments reduced to the level of the sea, finds the following expression of the length of the pendulum,

\[
0.090787 + 0.0053982 \text{ fin.}^2 \text{ latitude.}
\]

"In this expression I have diminished by the two-thousandth of a millimetre the result of Borda upon this length, for the correction of the radius of the cylinder, which formed the knife edge; a radius which I value at eight thousandths of a millimetre.

"The experiments now about to be made with particular care, in the two hemispheres, will shed new light on the coefficient of the square of the sine of the latitude, or on the variation of weight on the surface of the earth."

From the above formulas we have computed the following table, and have found the earth's ellipticity to be \( \frac{1}{298.2} \). By this also the increase of the weight of a body from the equator to the poles is \( \frac{1}{298.2} \) of the whole, whereas that deduced from the Mecanique Celeste is \( \frac{1}{299.2} \), which proportion has been adopted by Poisson, Biot, and other writers on the subject.

<p>| Table showing the comparative Weight of Bodies on different Parts of the Earth's Surface, with the proportional Length of the Seconds Pendulum, and also its daily Number of Vibrations in each Latitude: supposing it correct at the Greenwich Observatory, that is vibrating 86400 Seconds in 24 Hours. |</p>
<table>
<thead>
<tr>
<th>Degrees of Latitude.</th>
<th>Weight of 1000 lb. in different Latitudes.</th>
<th>Length of the Pendulum.</th>
<th>Number of Vibrations in each Latitude.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Metres.</td>
<td>English Inches.</td>
</tr>
<tr>
<td>0° 0' 0&quot;</td>
<td>100.000</td>
<td>0.990787</td>
<td>39.0083</td>
</tr>
<tr>
<td>5</td>
<td>100.0042</td>
<td>0.990828</td>
<td>39.0090</td>
</tr>
<tr>
<td>10</td>
<td>100.0165</td>
<td>0.990950</td>
<td>39.0147</td>
</tr>
<tr>
<td>15</td>
<td>100.0366</td>
<td>0.991149</td>
<td>39.0226</td>
</tr>
<tr>
<td>20</td>
<td>100.0637</td>
<td>0.991418</td>
<td>39.0331</td>
</tr>
<tr>
<td>25</td>
<td>100.1073</td>
<td>0.991751</td>
<td>39.0402</td>
</tr>
<tr>
<td>30</td>
<td>100.1362</td>
<td>0.992136</td>
<td>39.0514</td>
</tr>
<tr>
<td>35</td>
<td>100.1793</td>
<td>0.992563</td>
<td>39.0672</td>
</tr>
<tr>
<td>40</td>
<td>100.2251</td>
<td>0.993017</td>
<td>39.0961</td>
</tr>
<tr>
<td>45</td>
<td>100.2724</td>
<td>0.993486</td>
<td>39.1145</td>
</tr>
<tr>
<td>50</td>
<td>100.3088</td>
<td>0.993846</td>
<td>39.1287</td>
</tr>
<tr>
<td>54</td>
<td>100.3198</td>
<td>0.993955</td>
<td>39.1330</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.994091</td>
<td>39.1383</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.994094</td>
<td>39.1385</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.994099</td>
<td>39.1385</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.994360</td>
<td>39.1509</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.994361</td>
<td>39.1577</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.994521</td>
<td>39.1829</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.994554</td>
<td>39.1960</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.994563</td>
<td>39.2065</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.994623</td>
<td>39.2144</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.994624</td>
<td>39.2192</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.994618</td>
<td>39.2208</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.994619</td>
<td>39.2208</td>
</tr>
</tbody>
</table>
In computing the foregoing table we have, as on former occasions in this work, reckoned the French metre at 39.371 English inches, and the correction of this measure is of the greatest importance to science. It was that originally determined by M. Pictet, in the National Institute, by comparing the platinum metre with the brass yard made by Mr. Troughton, which was agreed upon by the Royal Society of London, as the best medium among our different standards, and the most accurate in its divisions. In making the necessary deductions for the effects of temperature on the different metals, Borda's tables of expansion were used; but from other tables and standards different lengths of the metre have been determined; particularly by Dr. Maltey, who made it 39.370226, and lately by Capt. Kater, who comes still nearer to Pictet, making it 39.37071. But unless such measurements are made from the same standard yard, and with the same tables of expansion, perfect agreement cannot be expected; and then it will be necessary to determine the important question, whether such tables and standards are quite correct. In short, an approximation to perfect accuracy is as much as can be hoped for. It is, however, satisfactory to observe, that the difference between the determinations of M. Pictet and Capt. Kater is scarcely discernible, even in the most delicate operations of an observatory, as it does not amount, when applied in measuring the pendulum, to more than one-third of a second in twenty-four hours. But for all general purposes the difference is wholly imperceptible.

This near agreement, therefore, confirms the propriety of our continuing Pictet's measure, which is sanctioned by general usage both in England and France, and has the additional advantage of numerical simplicity, which, for commercial purposes, is no slight recommendation.

Before we enter upon the subject of commercial weight, some general views ought to be given of the operations now about to take place on the pendulum in the two hemispheres, as alluded to in our quotation from Laplace.

The experiments intended by the French, in a voyage of discovery to the southern hemisphere, are to be made with pendulums of an extremely simple construction, the astronomical rates of which are previously ascertained at the Paris observatory. In these pendulums no maintaining power is applied, nor any compensation for temperature. The thermometer, therefore, and the magnitude of the arc of vibration, must be continually observed, and the necessary corrections applied, as in the experiment of Borda explained in Delambre's Astronomie, vol. iii. p. 579. Pendulums of a similar construction were employed by the French astronomers, M. Biot and M. Arago, at the royal observatory of Greenwich, and in other parts of Great Britain during the last year (1817); but the result of their experiments has not yet reached us.

A very correct and beautiful apparatus has lately been erected at our royal observatory, for the purpose of measuring the length of the pendulum; and also with a view of determining, with extreme exactness, the difference of the force of gravity at Greenwich and Paris, or, in other words, the comparative weight of bodies in the two latitudes.

This apparatus does not very essentially differ from that of Borda, except that a cylindrical rod of a given length is assumed as a standard, and the difference between this cylinder and the whole vibrating system is determined by a micrometer motion given to the feel table. In the French apparatus the feel table remains fixed, and the measuringrod is lengthened by means of a screw, till the lower surface comes in contact with the plane of the table.

We have likewise observed, that in Mr. Pond's apparatus, the pendulum of the clock is, by an ingenious contrivance, brought almost into contact with the experimental pendulum, by which the coincidences can be distinctly observed with a high optical power.

In the expedition which has been lately sent by the British government to explore the arctic regions, experiments are to be made for similar purposes, but with different apparatus. Two famous clocks, by Shelton, which were used by captain Cook, are sent. Each is furnished with a new brass pendulum of an entire piece, which can only vary in length by change of temperature, and this is to be allowed for from constant observation of the thermometer.

The rates of the clocks in London have been accurately determined; and if the fame can be ascertained at or near the pole, the result will be very important.

In concluding our view of the philosophy of weight, its varieties on the surfaces of the planets should be noticed; which are determined on the same principles as on the surface of the earth. See Planet, and System.

The weight of bodies on the surface of the sun is computed by Laplace to be about twenty-five times greater than that of the earth; without, however, allowing for the diminution of gravity by centrifugal force, which he calculates to be about $\frac{1}{2}$. See Centripetal Force.

Weight, in Commerce, denotes the quantity of any commodity or substance, which is determined by being placed in a scale against some known standard or weight. The art of weighing is therefore of the utmost importance, as it furnishes the usual practical means of ascertaining the quantity of matter in any given body, and thence the value of most of the necessaries of life.

Weights are generally made of stone, iron, lead, brass, or mixed metal; and they are mostly stamped by proper authorities, denoting that they have been fixed or compared with some known or legal standard. See Standard, and also Measure.

The weights of all nations differ from each other, and frequently in the same country a great diversity prevails. The common denomination is the pound, of which there are mostly two sorts, one for weighing the precious metals, and the other for common articles; such are the troy andavoirdupois weights in England. The former is generally divided into twelve ounces, and the latter into sixteen. But their division and multiples, as well as relative proportions, are extremely various. We shall consider them here under two distinct heads, viz., Ancient Weights, and Modern Weights.

Ancient Weights. — From the great importance of weights and measures, their adjustments must have been coeval with the first regulations of civil society; and hence their origin is too remote to be traced by any authentic history. The only ancient weights that are known with any degree of certainty are those of the Jews, Greeks, and Romans.

The ancient Jews, having no stamped coin, weighed all their gold and silver in the following simple manner, dividing their talent into 50 maneh, and their maneh into 60 thekels.

Table
## WEIGHT.

**Table I.**—Jewish Weights reduced to English Troy Weight (from Arbuthnot).

<table>
<thead>
<tr>
<th>Shekel</th>
<th>lb.</th>
<th>oz.</th>
<th>pwt.</th>
<th>gr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>60 Maneh</td>
<td>0</td>
<td>0</td>
<td>9</td>
<td>2 2%</td>
</tr>
<tr>
<td>3000 Talent</td>
<td>113</td>
<td>10</td>
<td>1</td>
<td>102</td>
</tr>
</tbody>
</table>

*Note.*—In reckoning money, 50 shekels made a maneh; but in weight, 60 shekels.

**Table II.**—Grecian and Roman Weights reduced to English Troy Weight (from Arbuthnot).

<table>
<thead>
<tr>
<th>Lentes</th>
<th>lb.</th>
<th>oz.</th>
<th>pwt.</th>
<th>gr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 Siliquae</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3 3%</td>
</tr>
<tr>
<td>12</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>9 3%</td>
</tr>
<tr>
<td>24</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>18 3%</td>
</tr>
<tr>
<td>72</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>6 3%</td>
</tr>
<tr>
<td>96</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3 0 2%</td>
</tr>
<tr>
<td>144</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>4 13 3%</td>
</tr>
<tr>
<td>192</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>6 1 3%</td>
</tr>
<tr>
<td>576</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>18 5 3%</td>
</tr>
<tr>
<td>6912 Libra</td>
<td>-</td>
<td>0</td>
<td>10</td>
<td>18 13 3%</td>
</tr>
</tbody>
</table>

For the subdivisions of the Roman as, libra, or pound, see As.

**Table III.**—Ancient Roman Weights reduced to English Troy Weight (from Pauclton).

| Siliqua Keration | - | - | - | - | - | - | - | - |
| Simplium | - | - | - | - | - | - | - | - |
| Sextans of Celsus | - | - | - | - | - | - | - | 3 |
| 3\% | - | - | - | - | - | - | - | 9 |
| 3\% | - | - | - | - | - | - | - | 10 3\% |
| 6 | - | - | - | - | - | - | - | 18 |
| 18 Denarius of Nero | - | - | - | - | - | - | - | 54 |
| 20\% | - | - | - | - | - | - | - | 61 3\% |
| 24 Sextula | - | - | - | - | - | - | - | 72 |
| 36 | - | - | - | - | - | - | - | 10 3\% |
| 48 | - | - | - | - | - | - | - | 43 3\% |
| 144 | - | - | - | - | - | - | - | 51 8 3\% |
| 1728 Centumpondium | - | - | - | - | - | - | - | 518 4 |

| English Grains | - | - | - | - | - | - | - | - |
| 3 | - | - | - | - | - | - | - | - |
| 9 | - | - | - | - | - | - | - | - |
| 10 3\% | - | - | - | - | - | - | - | - |
| 18 | - | - | - | - | - | - | - | - |
| 54 | - | - | - | - | - | - | - | - |
| 61 3\% | - | - | - | - | - | - | - | - |
| 72 | - | - | - | - | - | - | - | - |
| 10 3\% | - | - | - | - | - | - | - | - |
| 43 3\% | - | - | - | - | - | - | - | - |
| 51 8 3\% | - | - | - | - | - | - | - | - |

Vol. XXXVIII.
Table IV.—Other Divisions of the Roman Pound (from Paufton).

| Uncia | 2 | Sextans | 3 | 1\(\frac{1}{2}\) | Quadrans, triunx, teruncium | 4 | 2 | 1\(\frac{1}{4}\) | Triens | 5 | 2\(\frac{1}{2}\) | 1\(\frac{1}{2}\) | 1\(\frac{1}{4}\) | Quincunx | 6 | 3 | 2 | 1\(\frac{1}{2}\) | 1\(\frac{1}{4}\) | Sexunx, femis | 7 | 3\(\frac{1}{2}\) | 2\(\frac{1}{2}\) | 1\(\frac{1}{4}\) | 1\(\frac{1}{3}\) | 1\(\frac{1}{4}\) | Septunx | 8 | 4 | 2\(\frac{1}{2}\) | 2 | 1\(\frac{1}{4}\) | 1\(\frac{1}{3}\) | 1\(\frac{1}{4}\) | Des, belli, des | 9 | 4\(\frac{1}{2}\) | 3 | 2\(\frac{1}{2}\) | 1\(\frac{1}{2}\) | 1\(\frac{1}{4}\) | 1\(\frac{1}{3}\) | 1\(\frac{1}{5}\) | Dodranx, nonnuncium | 10 | 5 | 3\(\frac{1}{2}\) | 2\(\frac{1}{2}\) | 2 | 1\(\frac{1}{4}\) | 1\(\frac{1}{3}\) | 1\(\frac{1}{6}\) | Dextans | 11 | 5\(\frac{1}{2}\) | 3\(\frac{1}{2}\) | 2\(\frac{1}{2}\) | 2\(\frac{1}{4}\) | 1\(\frac{1}{4}\) | 1\(\frac{1}{3}\) | 1\(\frac{1}{6}\) | Deunx | 12 | 6 | 4 | 3 | 2\(\frac{1}{2}\) | 2 | 1\(\frac{1}{4}\) | 1\(\frac{1}{3}\) | 1\(\frac{1}{4}\) | 1\(\frac{1}{6}\) | 1\(\frac{1}{12}\) | Libra, as, pondo | 5184

The weight of the Roman denarius, ounce, and pound, is otherwise stated as follows:

By Arbuthnot, the Denarius, (7th part of the Ounce) 62,4

By Christiani, the Denarius, (8th part of the Ounce) 51,9

Modern Weights, or rather weights used in modern times, are in general very remote in their origin. We shall begin with British weights, and follow with those of France, making accurate comparisons between both; after which the divisions of the weights of the principal trading places in Europe, and other parts of the world, will be given; with tables of their relative proportions, extracted, by permission, from the Universal Cambist.

English Weights.—By the twenty-seventh chapter of Magna Charta, the weights are to be the same all over England; but for different commodities there are two sorts, viz. troy weight, and avoirdupois weight.

The origin from which they are both raised is the grain of wheat, gathered in the middle of the ear: 32 of these well dried make one penny-weight, 20 penny-weights 1 oz., and 12 oz. 1 lb. troy. Stat. 51 Hen. III. 31 Edw. I. 12 Hen. VII.

By the laws of assize, from the reign of William the Conqueror to the reign of Henry VII., the legal pound weight contained a pound of 12 ounces, raised from 32 grains of wheat, and the legal gallon measure invariably contained 8 of those pounds of wheat, 8 gallons made a bushel, and 8 bushels a quarter.

Henry VII. altered the old English weight, and introduced a pound, under the name of troy, which exceeded the old Saxon pound by \(\frac{1}{4}\) of an ounce: in proof of this it is alleged, that Henry VIII. when he abolished the old pound in the eighteenth of his reign, and established the troy, declares that the troy pound exceeded the old pound by \(\frac{1}{3}\) of an ounce.

This troy pound now in use, consisting of 12 ounces, contains 5760 troy grains, and the ounce therefore contains 460 grains; consequently 360 grains, equal to \(\frac{1}{4}\) of the ounce, deducted from 5760, leave 5400 troy grains, equal to the weight of the old Saxon pound which he abolished. It appears, therefore, that the old Saxon pound was \(\frac{3}{4}\) of the present troy pound; and as the avoirdupois pound of 16 ounces contains 7000 troy grains, the old Saxon pound was \(\frac{3}{4}\) of the present avoirdupois pound.

Although formerly 32 grains made a penny-weight, it has in later times been thought sufficient to divide the penny-weights into 24 equal parts called grains, being the least weights now in common use.

The first statute that directs the use of the avoirdupois weight is that of 24 Henry VIII., which plainly implies that it was no legal weight till that statute gave it a legal sanction; and the particular use to which the said weight is thus directed, is simply for weighing butcher's meat in the market. How or when it came into private use is not clearly known. Phil. Tranf. vol. lxxv. part i. art. 3.

Table V.—Of Troy Weight, as used by the Goldsmiths, &c.

| Grains. | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
| 24 | Penny-weight. |
| 480 | 20 | Ounce. |
| 5760 | 240 | 12 | Pound. |

The grain troy is divided into 20 mites, the mite into 24 doits,
WEIGHT.

Table VI.—Of Troy Weight, as used by the Apothecaries.

<table>
<thead>
<tr>
<th>Grains</th>
<th>Troy Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>Scruple</td>
</tr>
<tr>
<td>60</td>
<td>Drachm</td>
</tr>
<tr>
<td>480</td>
<td>Ounce</td>
</tr>
<tr>
<td>5760</td>
<td>Pound</td>
</tr>
</tbody>
</table>

This weight is essentially the same as troy weight, but differently divided. It is chiefly used for medical prescriptions: but drugs are mostly bought and sold by avoirdupois weight.

Table VII.—Diamond Weight.

Diamonds and other precious stones are weighed by carats, the carat being divided into 4 grains, and the grain into 16 parts. The diamond carat weighs $\frac{3}{4}$ grains troy: thus,

<table>
<thead>
<tr>
<th>Diamond Weight</th>
<th>Troy Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 Parts</td>
<td>1 Grain</td>
</tr>
<tr>
<td>4 Grains</td>
<td>1 Carat</td>
</tr>
</tbody>
</table>

Table VIII.—Of Avoirdupois Weight.

<table>
<thead>
<tr>
<th>Drachms</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
</tr>
<tr>
<td>256</td>
</tr>
<tr>
<td>7168</td>
</tr>
<tr>
<td>28672</td>
</tr>
<tr>
<td>57340</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pound</th>
</tr>
</thead>
<tbody>
<tr>
<td>144 lb.</td>
</tr>
<tr>
<td>192 oz.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Quarter</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 lb.</td>
</tr>
<tr>
<td>1 oz.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hundred</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 lb.</td>
</tr>
<tr>
<td>1 oz.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ton.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000 lb.</td>
</tr>
</tbody>
</table>

The drachm is subdivided into three scruples, and each scruple into ten grains; the pound or 7680 grains avoirdupois = 7000 grains troy, and hence 1 grain troy = 1097 grains avoirdupois.

Hence also - 144 lb. avoirdupois = 175 lb. troy.

And - 192 oz. ditto - 175 oz. do.

The stone is generally 14 lb. avoirdupois weight, but for butcher's meat or fish it is 8 lb. Hence the hundred equals 8 stone of 14 lb. or 14 stone of 8 lb.

A stone of glass is 5 lb. A beam of glass 24 stone, or 120 lb.

The fother of lead is generally 19$\frac{1}{2}$ cwt. at Newcastle, 21 cwt. at Stockton, 22 cwt.

Hay and straw are sold by the load of 36 trusses.

The trusses of hay weighs 56 lb. and of straw 36 lb. The trusses of new hay is 60 lb. until the 11th of September.

A view of local varieties of English weights will follow the present article.

Table IX.—Wool Weight.

Wool, like other common articles, is weighed by the avoirdupois, but the divisions differ from the above table: thus,

<table>
<thead>
<tr>
<th>Pounds</th>
<th>Clove</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>6$\frac{1}{2}$</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

The Weights of Ireland are the same as those of England; and they are used for corn instead of measures, which seems to be the most correct method of dealing.

Weights of Scotland.—By the act of union passed in 1707, the weights and measures of England were to be adopted in Scotland, but their introduction there is by no means general.

The English troy weight and apothecaries' weight, however, are used throughout Scotland, in the same manner as in England, with the exception that the Scotch jewellers divide the troy ounce into 16 drops, each drop being 30 troy grains; whereas the English divide it into 20 pennyweights, and a penny-weight into 24 grains, as before stated.

The English avoirdupois weight is used for the sale of leather, soap, sugar, tea, flour, candles, and other groceries; also for selling robe, wax, pitch, wrought metals, some Baltic goods, and all goods brought from England.

Scottish troy weight, also called Amsterdam and French Weight, is used for weighing iron, hemp, flax, Baltic and Dutch goods, meal, butcher's meat, unwrought pewter and lead, and likewise for some more articles. The pound, 16 of which compose a fone, contains 7576 troy grains; it is consequently nearly 9 per cent. heavier than avoirdupois, or 100 lbs. are equal to 108$\frac{1}{2}$ lbs. avoirdupois.

Trone Weight.—This weight was abolished by act in 1618. Its name is still retained in selling butter, cheese, tallow, wool, lint, hemp, yame, and some other home commodities; but the troy fone and pound are generally denominated by avoirdupois pounds and ounces. The trone pound always contains the same number of ounces avoirdupois, as the fone contains pounds. The weight of the fone, however, is variable. It appears from a recent publication (Kelly's Metrology), that there are about thirty different fytems of weights and measures in Scotland.

Weights of France.—In order fully to explain this important part of our article, three different weights must be noticed; viz. the ancient fytem, called the "Poids de Marc;" the "Metrical Systeem," begun in 1795; and the "Systeme Ufnuel," sanctioned by an Imperial decree of 1812.

The old French weight (poids de marc), the pound or livre, contains 2 mares, 16 ounces, 128 gros, 384 demiers, and 9216 grains, and equals 7556 grains troy. The new or metrical fytem, also called the decimal fytem, has been already explained under our article STANDARD. The following are its divisions, with its proportion to the poids de marc and English troy weight. The gramme is the element of all weights, and it is multiplied and divided by tens in the following terms:

<table>
<thead>
<tr>
<th>The word Deci prefixed means</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 times.</td>
</tr>
<tr>
<td>Hello</td>
</tr>
<tr>
<td>Kilo</td>
</tr>
<tr>
<td>Myria</td>
</tr>
</tbody>
</table>

On the contrary, for divisors, the word Deci expresses the 10th part, Centi - 100th part, and Milli - 1000th part.
WEIGHT.

<table>
<thead>
<tr>
<th>Table X.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pois de Mare.</td>
</tr>
<tr>
<td>Bar or Cubic</td>
</tr>
<tr>
<td>Metre of Water</td>
</tr>
<tr>
<td>Myriagramme</td>
</tr>
<tr>
<td>Kilogramme</td>
</tr>
<tr>
<td>Hectogramme</td>
</tr>
<tr>
<td>Decagramme</td>
</tr>
<tr>
<td>Gramme</td>
</tr>
<tr>
<td>Decigramme</td>
</tr>
<tr>
<td>Centigramme</td>
</tr>
</tbody>
</table>

The gramme weighs 5.648 drachms avoirdupois, and the kilogramme 35.3 oz. or 2 lb. 3 oz. 4.8 drachms avoirdupois. The Quintal Metrique, therefore, weighs 1 cwt. 3 qr. 24 lb. avoirdupois.

The pound of the Systeme Ufue, is the half kilogramme; but the divisions are binary, according to the ancient system.

Weights of Spain.—The Castilian mark is used for the precious metals. In weighing gold, it is divided into 50 castellanos, 400 tomines, or 4800 grains; but for silver, the same mark is divided into eight ounces, 64 ochavos, 128 adarmes, 384 tomines, or 4608 grains. The commercial weight is also Castilian. The pound is divided into 2 marks, 16 ounces, 128 drachms, or 9216 grains.—25 pounds = 1 arroba; 4 arrobas = 1 quintal.

Weights of Portugal.—Gold and silver are weighed by the mark of 8 ounces; the ounce being subdivided into 8 outavas, 24 escruloses, or 576 grains. The commercial pound is divided into 2 marks or 16 ounces, the ounce into 8 outavas or 576 grains.—32 lb. = 1 arroba; 4 arrobas = 1 quintal.

Weights of Holland.—Gold and silver are weighed by the mark of 8 ounces. The ounce is divided into 10 engels or efters; the engel into 32 as. Thus the mark weighs 512 as. The commercial pound is 40 as heavier than the above pound Troy. It is divided into 2 marks, 16 ounces, 32 loots, or 128 drachms.—8 lb. = 1 flone; 15 lb. = 1 lipond; 100 lb. = 1 centner; and 300 lb. = 1 shippond.

A new system of monies, weights, and measures, similar to the decimal system of France, has been lately decreed for Holland, Brabant, and Flanders, by the king of the Netherlands.

Weights of Germany.—The weight for gold and silver is not the same in all parts of Germany, but the Cologne mark is everywhere the standard weight for coins. It is divided into 8 ounces, 16 loths, 256 pfenings, 512 hellers, 4352 ecken, or 65536 richt-pfenings. The pound or pfund commercial weight is generally divided into 2 marks, 16 ounces, 32 loths, or 128 quarts, 512 pfenings, or 1024 hellers. The larger weights are the shippond, the centner or quintal, the lipond, and the flöen; but they do not in all places contain the same number of pounds, and their divisions as well as relative proportions are extremely various throughout the empire.

Weights of Italy.—The weights of Italy are various both in their divisions and relative proportions. Thus, at Rome, the pound for weighing gold and silver is divided into 12 ounces, the ounce into 12 drachms, 24 denari or scrupoli, or 48 oboli, or 144 filique or 576 grani. At Naples, the pound or libra is divided into 12 ounces, the ounce into 30 trapezi, and the trapefo into 20 acini. At Genoa, Florence, Leghorn, and Milan, it is divided into eight ounces, the ounce into 24 denari or 576 grani. At Venice, the marc is divided into 8 ounce, 32 quarts, 192 denari, 1152 carati, or 4608 grani. The commercial weight in most of the above places is the last for light goods as for gold and silver, and is called pecho fottile; but a heavier weight is used for coarse commodities, and is called pecho groffo. Their cantaro or quintal varies from 100 to 250 lb., and in some places the great cantaro is 1000 lb.

Weights of Denmark.—The pound for gold and silver contains 2 marks, 16 ounces, 32 loths, 128 quarts, or 512 ors or pfenings. The pound commercial weight is divided like that for the precious metals. The shippond contains 320 lbs. 20 liponds, or 3 ½ centners.

Weights of Sweden.—The mark for the precious metals contains 4384 as; but for commercial purposes there are four other weights, viz. the vicuallia-wigt, divided into 32 lods or 128 quarts; the bergs-wigt or miner’s weight, the landlord-gigt, and the metal-wigt. The pound of each of the three latter is divided into 16 lods, or 64 quintals.

Weights of Russia.—The pound in Russia used for all commodities is divided into 32 loths, or 96 florinticks.—40 lb. = 1 pound, and 10 pounds = 1 quarter.

Weights of Asia.—The weights of Asia are far too numerous and various in their divisions for our limits; but it may be observed, that decimal divisions are more general there than in Europe.

Weights of Africa.—Upon the Barbary coast, and in Egypt, the weights are similar to each other in their divisions, but very different in their relative proportions. The principal weight is the cantaro, divided into 100 rottoli, which is likewise used in Italy, Constantinople, and several places in the Levant.

Weights of America.—The weights and measures generally used in America, are those of the countries by which the different settlements were originally colonized. Thus the Spanish weights are retained in all parts of South America except Brazil, where those of Portugal are used. In the United States of North America, the English system of weights and measures is still continued, although several plans have been proposed for changing them.

Comparison of Weights.—The following Tables shew the relation between English and foreign weights. Also the proportion of the latter to each other, which is found by a single stating in the Rule of Three, as in the following examples:

**Example 1.**—How many marks of Berlin weight are equal to 560 kilogrammes of France?

Because 159.29 marks of Berlin = 100 lb. English Troy (per Table XI.), and 37.31 kilogrammes, by the same Table, = 100 lb. English Troy; it follows that 37.31 kilogrammes = 159.29 marks of Berlin; therefore, say,

As 37.31 kilog. : 159.29 marks :: 560 kilog. : 2392.84 marks.

**Example 2.**—How many pounds commercial weight of Amsterdam are equal to 276 pounds of Leghorn?

Here, by Table XII., 91.81 lb. of Amsterdam = 133.56 lb. of Leghorn, both being equal to 100 lb. Avoirdupois; therefore,

As 133.56 lb. of Leghorn : 91.81 lb. of Amsterdam :: 276 lb. of Leghorn : 189.7 lb. of Amsterdam.
TROY WEIGHT.

Table XI.—Containing a Comparison of the Troy, or Gold and Silver Weights of different Countries; and shewing the Number of Pounds, Marks, Ounces, &c. of each Place, that are equal to 100 Pounds English Troy; and also the Weight of a single Pound, Mark, Ounce, &c. in English Troy Grains.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Amsterdam</td>
<td>Marks</td>
<td>151.68</td>
<td>E. Grains.</td>
<td></td>
</tr>
<tr>
<td>Antwerp</td>
<td>The same</td>
<td>158.11</td>
<td>Leghorn</td>
<td>(See Florence.)</td>
</tr>
<tr>
<td>Augsburg</td>
<td>Marks</td>
<td>159.29</td>
<td>Lisbon</td>
<td>(See Cologne.)</td>
</tr>
<tr>
<td>Basil</td>
<td>(See Cologne.)</td>
<td>151.18</td>
<td>Lubec</td>
<td>(See Cologne.)</td>
</tr>
<tr>
<td>Berlin</td>
<td>Marks</td>
<td>3232.32</td>
<td>Madrid</td>
<td>(See Spain.)</td>
</tr>
<tr>
<td>Bern</td>
<td>Marks</td>
<td>3323.22</td>
<td>Malabar</td>
<td>(See Madras.)</td>
</tr>
<tr>
<td>Bombay</td>
<td>Tolas</td>
<td>182.39</td>
<td>Malta</td>
<td></td>
</tr>
<tr>
<td>Bremen</td>
<td>(See Cologne.)</td>
<td>3158</td>
<td>Milan</td>
<td></td>
</tr>
<tr>
<td>Breidau</td>
<td>Marks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bruxelles</td>
<td>(See Amsterdam.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cadiz</td>
<td>(See Spain.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cairo</td>
<td>Rottoli</td>
<td>86.56</td>
<td>Naples</td>
<td></td>
</tr>
<tr>
<td>Calicut</td>
<td>Mificals</td>
<td>8347.82</td>
<td>Naples</td>
<td></td>
</tr>
<tr>
<td>China</td>
<td>Tales</td>
<td>993.79</td>
<td>Naples</td>
<td></td>
</tr>
<tr>
<td>Cologne</td>
<td>Marks</td>
<td>159.04</td>
<td>Naples</td>
<td></td>
</tr>
<tr>
<td>Constantinople</td>
<td>Chekies</td>
<td>117</td>
<td>Naples</td>
<td></td>
</tr>
<tr>
<td>Cracow</td>
<td>Marks</td>
<td>178.68</td>
<td>Naples</td>
<td></td>
</tr>
<tr>
<td>Damascus</td>
<td>Metecals</td>
<td>8347.82</td>
<td>Naples</td>
<td></td>
</tr>
<tr>
<td>Dantzig</td>
<td>Marks</td>
<td>195.42</td>
<td>Naples</td>
<td></td>
</tr>
<tr>
<td>Denmark</td>
<td>Marks</td>
<td>158.95</td>
<td>Naples</td>
<td></td>
</tr>
<tr>
<td>England</td>
<td>Pounds Troy</td>
<td>100</td>
<td>Naples</td>
<td></td>
</tr>
<tr>
<td>Florence</td>
<td>Pounds</td>
<td>1200</td>
<td>Naples</td>
<td></td>
</tr>
<tr>
<td>Frankfort</td>
<td>(See Cologne.)</td>
<td>1385.89</td>
<td>Naples</td>
<td></td>
</tr>
<tr>
<td>France</td>
<td>Marks</td>
<td>152.44</td>
<td>Naples</td>
<td></td>
</tr>
<tr>
<td>Geneva</td>
<td>Marks (Or like France.)</td>
<td>152.15</td>
<td>Naples</td>
<td></td>
</tr>
<tr>
<td>Genoa</td>
<td>Libre</td>
<td>117.45</td>
<td>Naples</td>
<td></td>
</tr>
<tr>
<td>Hamburg and</td>
<td>Venice</td>
<td>150.50</td>
<td>Naples</td>
<td></td>
</tr>
<tr>
<td>Hanover</td>
<td>(See Cologne.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Holland</td>
<td>(See Amsterdam.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Konigberg</td>
<td>Marks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Avoirdupois
### Avoirdupois Weight

Table XII.—Containing a Comparison of the Commercial Weights of different Places; and shewing the Number of Pounds, &c. of each Place that are equal to 100 Pounds Avoirdupois; and also the Weight of a single Pound, &c. in English Troy Grains, 7000 of which weigh one Pound Avoirdupois.

<table>
<thead>
<tr>
<th>Place</th>
<th>Weight of 100 lbs. Avoirdupois</th>
<th>Weight of a single lb. Avoirdupois</th>
<th>Weight of 100 lbs. Troy</th>
<th>Weight of a single lb. Troy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aix la Chapelle</td>
<td>Pounds - 96.76</td>
<td>E. Grains - 7234</td>
<td>Calemburg - Pounds - 93.19</td>
<td>E. Grains - 7511</td>
</tr>
<tr>
<td>Aleppo</td>
<td>Rottoli of 720 dros. - 19.89</td>
<td>35190</td>
<td>Calcut - Seysras - 103.35</td>
<td>493</td>
</tr>
<tr>
<td></td>
<td>Do. of 700 dros. - 20.46</td>
<td>34212</td>
<td>Candia - Rottoli - 85.91</td>
<td>8148</td>
</tr>
<tr>
<td></td>
<td>Do. of 680 dros. - 21.06</td>
<td>33235</td>
<td>Carthagena - (See Spain.)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Do. of 600 dros. - 23.87</td>
<td>29325</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Okas of 400 dros. - 35.80</td>
<td>19550</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alexandria</td>
<td>Rottoli Forfori - 19.7</td>
<td>6542</td>
<td>Caffel - Pounds - 93.32</td>
<td>7591</td>
</tr>
<tr>
<td></td>
<td>Zaydini - 74.90</td>
<td>9345</td>
<td>Castile - (See Spain.)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Zauri - 48.32</td>
<td>14485</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mine - 59.92</td>
<td>11682</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Algiers</td>
<td>Rottoli - 84</td>
<td>8330</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alicant</td>
<td>Great pounds - 87.48</td>
<td>8002</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Light pounds - 131.20</td>
<td>5335</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Altona</td>
<td>(See Hamburgh.)</td>
<td></td>
<td>Copenhagen - Pounds - 90.80</td>
<td>7725</td>
</tr>
<tr>
<td>Amsterdam</td>
<td>Pounds - 91.80</td>
<td>7625</td>
<td>Corfu - Pounds - 111.17</td>
<td>6304</td>
</tr>
<tr>
<td>Ancona</td>
<td>Pounds - 136.05</td>
<td>5145</td>
<td>Corrica - Pounds - 131.72</td>
<td>5135</td>
</tr>
<tr>
<td>Antwerp</td>
<td>Pounds - 96.75</td>
<td>7355</td>
<td>Cremona - Pounds - 138.33</td>
<td>5060</td>
</tr>
<tr>
<td>Apothecaries' Weight</td>
<td>English pounds - 121.52</td>
<td>5760</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dutch pounds - 122.89</td>
<td>5666</td>
<td>Creusa - Pounds - 107.07</td>
<td>6508</td>
</tr>
<tr>
<td></td>
<td>German pounds - 126.65</td>
<td>5527</td>
<td>Creusa - Pounds - 133.56</td>
<td>5521</td>
</tr>
<tr>
<td></td>
<td>French pounds of 12 ounces - 123.50</td>
<td>5668</td>
<td>Dantzig - Pounds - 103.07</td>
<td>6791</td>
</tr>
<tr>
<td></td>
<td>Kilogrammes of 45.35</td>
<td>15435</td>
<td>Denmark - (See Copenhagen)</td>
<td></td>
</tr>
<tr>
<td>Archangel</td>
<td>(See Ruffia.)</td>
<td></td>
<td>Deventer - Pounds - 96.43</td>
<td>7539</td>
</tr>
<tr>
<td>Augsburg</td>
<td>Heavy pounds - 92.35</td>
<td>7580</td>
<td>Drefden - Pounds - 97.14</td>
<td>7206</td>
</tr>
<tr>
<td></td>
<td>Light pounds - 95.95</td>
<td>7295</td>
<td>Dunkirk - Pounds - 105.86</td>
<td>6612</td>
</tr>
<tr>
<td>Aurich</td>
<td>Heavy pounds - 83</td>
<td>8433</td>
<td>Elbing - Pounds - 106.73</td>
<td>6558</td>
</tr>
<tr>
<td>Bamberg</td>
<td>Pounds - 91.10</td>
<td>7666</td>
<td>Embden - Pounds - 91.79</td>
<td>7668</td>
</tr>
<tr>
<td>Barcelona</td>
<td>Pounds - 112.60</td>
<td>6216</td>
<td>England - Avoirdupois punds - 100</td>
<td>7000</td>
</tr>
<tr>
<td>Bafil</td>
<td>Pounds - 92.64</td>
<td>7556</td>
<td>Erfurt - Pounds - 96.08</td>
<td>7285</td>
</tr>
<tr>
<td>Baffano</td>
<td>Pounds - 132.82</td>
<td>5270</td>
<td>Ferrara - Pounds - 133.67</td>
<td>5237</td>
</tr>
<tr>
<td>Batavia</td>
<td>Catties - 76.78</td>
<td>9117</td>
<td>Florence - Pounds - 133.56</td>
<td>5521</td>
</tr>
<tr>
<td>Bengal</td>
<td>Seers - 53.57</td>
<td>13066</td>
<td>Frankfort - Pounds - 97.02</td>
<td>7210</td>
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### WEIGHT.

**Table XII.—continued.**

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Plan for the Revision of Foreign Weights, &c.—The commercial world will learn with satisfaction that a plan has lately been commenced, under the auspices of the British government, for revising the tables of comparison between foreign weights and measures; as it is well known that many of the tables in use abound in contradictory statements; and even where they agree, they are frequently found to differ from mercantile experience.

The origin of these tables of comparison cannot be traced. It is probable that they have been gradually formed through a long course of ages, from the casual reports of individuals in different countries. When, therefore, it is considered, how uncertain such reports must have been, and also to what changes weights and measures are exposed from decay, accident, or design, it is not surprising that so much confusion should be experienced, especially in tables where no general revision has ever taken place.

The only comparison of the kind upon record is that made in 1767, by M. Tillet, at the Paris Mint, by order of the French government. His operations, however, were confined to money weights, and those only of a limited number of places. His tables, as far as they extend, have been generally used, although their accuracy is, in many instances, disputed, especially by Kufe, and other German writers. Nelkenbrecker, in his elaborate work on monies, weights, and measures, published at Berlin in 1810, gives a long statement (page 508.) of discrepancies between Tillet’s reports and those of other assay masters.

But the most numerous and important errors are in the tables of commercial weights and measures; and therefore with a view of remedying an evil so perplexing to merchants, our government has recently issued an order to the British consuls abroad, to send home well-attested copies of foreign standard weights, that they may be accurately compared with those of England at his majesty’s mint. Correct statements are likewise required of the mathematical dimensions of measures of capacity, and of their comparative contents, as estimated and acted upon by merchants.

We have authority further to state, that the plan was examined and approved by the Board of Trade, on the 14th of January 1818; and, by their lordships’ recommendation, the order to the consuls has been issued from the foreign-office, by Viscount Castlereagh.

The copies of standards thus transmitted to London are to be weighed and compared by Robert Bingley, esq. F.R.S., the king’s assay-master of the Mint; and the results of these important comparisons are to be published by Dr. Kelly, who projected the plan, and who will perform the calculations. The revised tables are expected to be brought out in the second edition of his Cambiit; and should they be printed before our Cyclopædia is finished, we hope for the author’s permission to insert them in our Addenda.
WEIGHTS.

Weights and Measures, in Agriculture and Rural Economy, are of great consequence to the land-owner and the farmer, as being the proportions or quantities by which various sorts of produce, of the agricultural and other such kinds, are disposed of and sold. They are found to vary very greatly in different districts and parts of the country, as well as in different places and towns of the same district or county, and even in the markets of the same town. Consequently, the confusion, uncertainty, inconvenience, and losses which are thus produced, are often very great and troublesome. We have already, in the preceding article, observed, that the two principal weights established in Great Britain are the troy and avoirdupois weights, and by these most of the articles of farm produce, and those of many other kinds, are sold in this country.

There are some, however, that are disposed of in other ways, as will be seen below.

However, as the diversity of weights and measures (in different places) creates much perplexity and uncertainty in the purchase as well as disposal of different sorts of produce, it would not only be highly desirable, but convenient and advantageous, to have one universal standard or system of weights and measures. For an account of the attempts that have been made to obtain such a standard, see Standard.

Different Weights and Measures for Farm and other produce by Troy Weight.

- 24 Grains make 1 Pennyweight
- 20 Pennyweights = 1 Ounce
- 12 Ounces = 1 Pound
- 20 Hunds. weight = 1 Ton

By this weight are weighed gold, silver, amber, bread, corn, and all liquors—14 oz. 11 dwts. 15½ grains, or 292 dwts. nearly, are equal to a pound avoirdupois.

By Avoirdupois Weight.

- 16 Drams make 1 Ounce
- 16 Ounces = 1 Pound
- 4 Quarters = 1 Quarter
- 20 Hunds. weight = 1 Ton

By this weight are weighed all the farm produce, such as butter, cheese, and many other articles; and all metals, except those of the finer kinds. In other cases, 7½ Pounds make 1 Gallon of train-oil

In Wool Weight.

- 2 Cloves make 1 Stone
- 2 Stones = 1 Todd
- 6½ Todd's = 1 Weigh or Wey
- 2 Weys = 1 Sack
- 12 Sacks = 1 Laft

In Hay Weight.

- 56 Pounds of old hay, or 36 Truffes make 1 Trufi
- 36 Truffes = 1 Load

In Bread Weight.

- 1728 Cubic inches make 1 Cubic foot
- 27 Cubic feet = 1 Cubic yard
- 40 Feet of rough timber = 1 Load
- 50 Feet of hewn ditto = 1 Load

This comprehends length, breadth, and thickness.

Vol. XXXVIII.
WEIGHTS.

And 108 solid feet, that is, 12 feet in length, 3 feet in breadth, and 3 deep, or commonly 14 feet long, 3 feet 1 inch broad, and 3 feet 1 inch deep, are a fack of wood.

And 128 solid feet, that is, 8 feet long, 4 feet broad, and 4 feet deep, are a cord of wood.

In Coal Measure.

4 Pecks make 1 Bushel
3 Bushels 1 Sack
12 Sacks, or 36 bushels 1 Chaldron
21 Chaldrons 1 Score

In Corn Measure.

1 Load of corn makes 5 Bushels
1 Luff of ditto 43 Do.

It is enacted by 31 George III., that a Winchester bushel of corn should weigh as follows:

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<tr>
<td>lb.</td>
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<tr>
<td>Wheat 57 avoirdupois</td>
<td>Wheat meal 56</td>
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<tr>
<td>Barley 49</td>
<td>-</td>
</tr>
<tr>
<td>Bigg 42</td>
<td>-</td>
</tr>
<tr>
<td>Oats 38</td>
<td>-</td>
</tr>
<tr>
<td>Rye 55</td>
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After these statements of the different weights and measures which are in common use for different sorts of produce, it may not be improper to notice some of the differences of weights and measures, as they exist in different districts, towns, and parts of the kingdom, according to the account which has been given of them, and as they are injurious to the farmer.

In the counties or districts near the metropolis, the statute measures are pretty commonly employed, though there are many irregularities and deviations; but in those at some distance there are more frequent and remarkable variations and differences.

In the county of Middlesex, the weights and measures made use of are mostly those of the standard legal kind, and consequently the variations in them are but little.

Wood is sold by the fack, as packed three feet by three, and twelve feet long, containing in this manner 108 cubic feet.

Effex is now pretty much in the same state as above, in regard to its weights and measures, though formerly they varied very greatly, wheat being sold either by weight or measure, as agreed upon. The measure then eight gallons and a half the bushel; and the weight, that usually termed the peck weight, or the medium of what eight and a half of good wheat would weigh.

Then all other sorts of grain were sold by measure, but by that which was very different in different places, and for different sorts, the bushel of barley, malt, oats, &c. being often nine gallons; others eight and a half, and eight and three pints, &c. There are still some remains of these measures in the county. Various articles, too, are still sold there by the half, the dozen, the score, and the hundred of fix score, such as hop-poles, faggots, &c.

The writer of the Berkshire Agricultural Report remarks, that, notwithstanding the fines and forfeitures attached to selling corn by any other than the standard bushel, and the obvious ill consequences resulting from the practice without one counterbalancing advantage, that county, like most others, has its diversity of measures, which only encourages jobbers, to the prejudice of the grower of corn; who, influenced by habit, does not always take into consideration, that if he should sell nine gallons instead of eight to the bushel, he is giving a bushel in every quarter of grain more than the laws allow, or justice requires, and that the dealer is probably making that proportion of profit, out of his ignorance or obstinacy.

The owner of land cannot, therefore, more effectually secure his tenants, it is supposed, than by exerting themselves to introduce an uniformity of measure in their respective neighbourhoods.

The nine-gallon bushel prevails in some parts of the county, but in others the standard. At Faringdon and Wantage, the former is almost exclusively used; but at Abingdon both it and the standard bushel are employed. The former is the custom of the market, however, unless the contrary be specified; but malt sold out of the town is only eight gallons measure.

Corn is commonly sold by the load of five quarters. In building, hedging, and ditching, the perch or pole of eighteen feet is the usual measure.

Wood is sold by the foot, and load-underwood by the cord, in some places absurdly called a load, and by the proper load.

Besides the statute acre, there are also common field acres, which are sometimes more, and sometimes less, than the statute.

In weights the diversity is great in most places.

In the county of Salford, the weights and measures most commonly used are, the pound, stone, acre, load, bushel, &c. There are several sorts of acres, which are a great source of perplexity and confusion—the short acre, the statute acre, the field acre, and various others; the field acre is nine score rods; the statute, eight score; and the short acre, fix score in some places, in others five score. The stranger, unaware of the variations that prevail in the weights and measures, is, it is said, liable to fall into mistakes in every step he takes; and that until a radical reform is brought to bear, the present confusion in buying and selling malt prevail, and the honest and unsuspecting will be taken in by the crafty and designing.

In the other southern districts or counties, the variations in their weights and measures are much the same, though less than in those of the north.

It is stated in the Gloucester Report on Agriculture, that in the market of that town, the bushel varies from nine to ten gallons; in the forest district it is nearly ten gallons; on the Cotswolds about nine; in the vale nine and a half; and in the lower vale, and at Cirencester, nine and a quarter, of all sorts of grain.

Near Bristol, potatoes, green peas, &c. are sold by the double peck, containing two common ones, struck level with the top; while at Gloucester, and higher up the vale, it is a common peck heaped up. Wool is generally sold by the stone weight of 12 lbs., or the tod of 28½ lbs. Butter often by the pound of 18 oz.; and the quart of about 4 lbs.

In Herefordshire the peculiar weights and measures which are at present in use are these, according to the Survey on Agriculture for that district.

1 Pound of fresh butter 18 Ounces
1 Stone 12 Pounds
1 Common acre 3 Of a statute acre
1 Hop acre That space of ground which contains 1000 plants; viz. about ½
1 Lugg 49 Square yards of coppice-wood
WEIGHTS.

1 Wood acre - 3 1/2 Larger than a statute, i.e. as 8 are to 5
1 Day's math - 1/8 About a statute acre of meadow or grass land, being the quantity usually mown by one man in one day
1 Perch of fencing - 7 Yards
1 Perch of walling - 16 1/2 Feet
1 Perch of land - 5 1/4 Yards (as statute)
1 Bushel of grain - 10 Gallons
1 Bushel of malt - 8 1/2 Gallons.

In the Report on Agriculture for Shropshire, it is stated, that wheat, barley, and peas, are sold by the strike or bushel, which, in Shrewsbury market, is 38 quarts, but in other markets it is 40 quarts. That the 38 quarts of wheat should weigh 75 lbs., the 40 quarts 80 lbs. In other markets in the county, the bushel of wheat does not weigh more than 79 lbs. This is chiefly applicable to the eastern district of the county. The bushel of flour is everywhere 56 lbs. That 38 quarts of barley weigh about 65 lbs. That a bushel of oats means three half bushels of the customary measure at Shrewsbury, and should weigh better than 92 lbs. But that in other markets it means 2 1/2 bushels, sometimes heaped, sometimes sprinkled, and sometimes a medium between both. That a bag of wheat means three bushels customary measure. The quarter bushel is called a hoop or peck; and the fourth of that is called a quarter.

Butter, when fresh, weighs 170 oz. to the pound; when salted, 16 oz. The half is reckoned by the gown, which signifies 12 lbs. of 16 oz. in Shrewsbury, and 16 lbs. of 16 oz. at Bridgnorth. Cheese is sold by the cwt., which, at Shrewsbury, means 121 lbs., and 113 lbs. at Bridgnorth. Coals are sold by the ton, which is 20 cwt. of 112 lbs. at some pits, and 120 lbs. at others; the slack is now rarely used; it was a measure of four feet square, and would sometimes weigh 25 cwt. Hay is sold by the ton, of 20 cwt. of 112 lbs. Home-made linen cloth is sold by the ell, which measures a yard and a half; and it is added, that the acre is the statute acre. That the workman’s rood in digging is eight yards square; but in hedging, eight yards in length.

It is suggested, too, that there is an error in the standard measure, that in the Exchequer not agreeing with the requisitions of the 13 Will. III. c. 5. By which statute, the bushel is ordered to be 18 1/2 inches round, and 8 deep; it would consequently contain

Cubic inches - - - - - - - - 2150
That in the Exchequer contains - - - 2124
Eight of the standard gallons - - - - - 2168
Thirty-two ditto quarts - - - - - - 2240
Sixty-four ditto pints - - - - - 2027

That the difference between the bushel and 32 of the quarters is, therefore, 116 cubic inches, or nearly three pints and a half.

It is stated, too, that in the northern part of the North Riding of Yorkshire, the customary bushel exceeds that of the Winchester, by full two quarts; but nearer to the southern extremity, seldom by more than one: the bushel of some individuals in the Riding is still larger, measuring about 10 per cent. more than the statute requires.

And further, that a stone of wool in York market is sixteen pounds, and four ounces in each stone are allowed for draught; that is, for the draught of each fleece, the wool-buyers being empowered by act of parliament to weigh each fleece separately, if they like. That at Ripon market,
of corn-meters is such, that it is asserted they can gain either to the buyer or seller from 10 to 20 per cent. in different modes of measurement; that 5 per cent. can be obtained by this practice, by even bunglers in the bushels; this is an enormous profit, and the unfairness of such practices merits the severe reprehension.

That at Preston the winde of wheat, beans, and barley, is three and a half Winchester bushels; but of late 220 lbs. have been reckoned a winde of wheat: they have also a measure there called a peck, which is twenty-eight quarts, four of which are called a winde.

In respect to weights, there are three different ones expressed under the general term hundred weight; namely, 100 lbs., 112 lbs., and 120 lbs. The stone, too, varies. In Liverpool, 20 lbs. are the weight allowed for the several articles under that denomination, as beef, hay, flax, &c.; and probably all the articles produced from land. And butter is required to weigh 18 ounces avoidnipes, or it may be seized by the magistrates.

At Lancaster, and the neighbourhood, they have several different weights, as the Lancaster peck, of twenty-four quarts; the common peck, of sixteen quarts; the half Winchester; the winde, of three and a half bushels; the met, of fifty-six quarts; the ackendale, or ackentdy, the eighth part of the above, or seven quarts, and the measure of four quarts. The load of malt is fix bushels.

Butter eighteen ounces to the pound; other articles sixteen.

There are also different local variations in many articles.

In Westmoreland, the pound consists of twelve, sixteen, eighteen, or twenty-one ounces; and the stone of fifteen, sixteen, or twenty pounds. There is also a Winchester bushel, a customary bushel equal to three of these, a bushel of two bushels for the sale of potatoes near Appleby, and one of two and a half for that of barley. Rye is sold by the boll of two bushels, and potatoes by the load of four bushels and a half heaped; or more generally a bag, which holds seven and a half bushels, is filled and sold for a load of potatoes.

There is the statute acre, too, of 4840 square yards, the customary acre of 6760 raised from the perch of fix and a half yards, and a third acre on the borders of Lancashire, raised from the perch of seven yards, containing 7840, being the same as the Irish plantation acre.

It is remarked, likewise, in the Cumberland Report on Agriculture, that the same confusion in weights and measures prevails there, as in many other parts of the kingdom.

That a Winchester bushel is thirty-two quarts; a Carlisle bushel, ninety-six quarts; and a Penrith bushel, sixty-four quarts, for wheat and rye; and eighty quarts, for barley, oats, and potatoes.

That a stone of tallow, wool, yarn, or hay, is 160s.; and a stone of butcher's meat 141s., but in many places 161s.

That the pound is sixteen ounces, by which butter and various other articles are weighed.

The writers of the Account of Agriculture for Northumberland, state that their weights and measures are in a sad state of confusion; a pound, a stone, a bushel, and a boll, are rarely the same in different markets, and frequently vary in the same market for different articles.

### At Hexham.

| 4 Quarts  | make | 1 Forpit |
| 4 Forpits | -    | -        |
| 4 Pecks   | -    | -        |
| 2 Bushels | -    | -        |

**For Oats and Barley.**

| 4 Quarts  | make | 1 Forpit |
| 4 Forpits | -    | -        |
| 4 Pecks   | -    | -        |
| 2 Bushels | -    | -        |

**At Alnwick.**

| 3 Quarts  | make | 1 Forpit |
| 3 Forpits | -    | -        |
| 3 Pecks   | -    | -        |
| 6 Bushels | -    | -        |

**At Wooler.**

| 4 Quarts  | make | 1 Forpit |
| 3 Forpits | -    | -        |
| 3 Pecks   | -    | -        |
| 6 Bushels | -    | -        |

That a stone of wool in some parts is 24 lbs.; in others, 18 lbs.; and a stone of every other article is 14 lbs.

As the weights and measures made use of in Scotland differ very materially from those employed in England, it may, of course, not be useless to give a cursory view of them under the present head. It has been observed by Mr. Somerville, in his Account of the Agriculture of East Lothian, that land is measured by the Scotch acre, which is to the English acre nearly in the proportion of five to four.

That the boll is the denomination of corn measure always used, but the contents vary according to the species of grain measured. But that there are uniformly four firlots in the boll of all grain; but the firlot differs in size in the proportion of 21, 25, to 31. Wheat, rye, beans, and peas, are sold by the small firlot; malt, barley, and oats, are sold by the large one. Four small firlots are 4087276 Winchester bushels; four large ones are 592663 bushels Winchester. The boll of wheat then is a small fraction more than half a quarter; and the boll of barley, a fraction less than three-fourths of a quarter. But this calculation applies, it must be remembered, to the Linlithgow boll, which is accounted the standard measure of Scotland: the measure actually used in East Lothian is somewhat larger.

In the Mid-Lothian Report on Agriculture, it is stated, that flour, pot-barley, groceries, iron, and ropes, are bought and sold there, by what is termed English weight, being 16 oz. to the pound, and 16 lbs. to the stone. But that butcher's meat, oatmeal, and flax, are bought and sold by what is called Dutch weight, of which the proportion to the English is as 17½ to 16.

That wool, hay, and butter, are bought and sold by stone weight, of which the proportion is to the English, as 22 to 16. That other articles are bought and sold by either of these weights, as it may happen.

But that in long measure the inch is the root, of which 12 go to the foot, and 37 to the Scotch yard.

And that land is measured by a chain 20 yards in length, or 74 feet, divided into 100 links, of 8.88 inches each in length; 10 square chains make an acre, or 5760 square yards Scotch, equal to 6084.444 English; and as the
the English acre consists of 48.40 square yards, hence the proportion that the Scotch acre bears to the English is, with a small fraction more, as 5 to 4, as seen above.

That in liquid measure the pint is the root, containing 103.404 cubic inches; the half and quarter in proportion.

That the Linlithgow wheat firlot, the only standard measure for that grain in Scotland, contains 214.8 pints; hence in cubic inches 2159.34. The Winchester bushel, in like manner the English standard, contains 2150.42 cubic inches; hence the Scotch wheat firlot is about 2\% per cent. greater than the English bushel.

And the Linlithgow barley measure, which is likewise the standard, contains 31 pints, or 3255.54 cubic inches; hence 51\% bushels are very nearly equal to the Scotch boll of 4 firlots.

That straw is sold by tale, 40 windlens to a kemple, generally noticed, that in East Lothian, meal is sold by the boll of eight pounds Amsterdam weight; and that the boll of meal contains sixteen pecks or eight stones.

It is stated in the Clydesdale Report on Agriculture, that in the dry measure, used in the fale of grain of all kinds, a boll contains four firlots, a firlot four pecks, and a peck four forpits or lippies; 16 bolls make a chaldar.

The firlot used to measure barley and oats, is almost one-third larger than the firlot for measuring wheat, beans, peas, \\&c. That both these measures are about one-sixteenth larger than the Linlithgow standards of the same denominations. But for more than thirty years past, wheat has been bought and sold by the Linlithgow standard, which is now attempted to be introduced for other grains.

That in the lower parts of the county potatoes have been measured, for these forty years, with a dish of the shape of a cauld, the peck measure holding fifteen Scotch pints; its weight, full of potatoes recently dug, is 43 lbs. avoirdupois. In the higher parts of the county potatoes are sold by the barley measure.

That the peck, or fliek, for measuring pears and apples, holds about eighteen pints. The confusion occasioned by the irregularity of weights and measures, is too obvious, the writer fays, to require any comment.

In the Argyllshire Agricultural Report, it is said that at Inverary the boll of meal is eight stone Scotch troy, or Dutch 17 lbs. avoirdupoise to the flone. At Campbellton it is ten stone, of the same weight; or sixteen pecks of 10 lbs. Scotch troy, or 10 lbs. 6 oz. avoirdupois each.

That in some parts of the Knapdale and Lorn, the boll is nine stone. That in the first of the above places, oats, barley, and malt, are measured by a firlot of 3438.18 cubic inches; equal to one firlot, two pints, one mutchkin, Scotch standard measure, which makes the boll (of four firlots) 7.258 per cent. better than the Scotch standard measure, and equal to six bushels, one peck, nine pints, 10.2 cubic inches, English standard measure.

And that in Kintyre, oats, barley, or bear and malt, were, for time immemorial, sold by a heaped peck, of which the standard lay with the dean of Guildin Campbellton. Of this measure, seventeen pecks made, and still make, the Kintyre boll from Augall to Patrickmas, and only sixteen from that date to the new crop; and the divisions of the boll are regulated by the same proportions. But from the inconvenience of measuring by the heaped peck, it has been converted into the struck one containing the same quantity; and this new struck peck committed to the dean of Guildin, has been since the standard of the district. The dimensions of it are twelve English inches diameter, equally wide throughout, and ten and a tenth English inches deep. The contents of it in cubic inches are 1142.28576, equal to eleven Scotch pints, and a very little more than two-thirds of a gill, which makes the Kintyre boll 1147.87502 cubic inches, before Patrickmas, and 1875.57216 after it. A lippie more, or 5/16 of a boll, for town dues, is given with every boll delivered in Campbellton. The third is equal to nine Winchester bushels, and 65.03112 cubic inches, (about 1/5 of a bushel) and equal to one boll eight pecks, 1.61788 lippies Linlithgow standard measure. The latter is equal to eight and a half Winchester bushels, excepting 2.0394 cubic inches, and to one boll six pecks, 3.44 lippies Linlithgow. The Winchester bushel contains 2150.42 cubic inches. The Linlithgow boll standard measure 12822.096.

That at Inverary, the peck of potatoes contains fourteen pints and one mutchkin, ale measure. At Campbellton, it contains about nine English wine gallons, and is given heaped; and generally weighs about 59 lbs. avoirdupois.

But that beans and peas are sold in Kintyre by the old peck struck, or by a measure one-third less than that for oats and bear. Linseed and liquid measures are the same with the Scotch standards. Butter, cheese, tallow, hay, wool, and lint, are sold by the stone of 24 lbs. avoirdupois. Butcher's meat by the pound of twenty-four ounces avoirdupois at Inverary, and of sixteen ounces at Campbellton. The herring-barrel contains thirty-two English gallons of wine measure, or 67.28 customary ale pints of 109.866 cubic inches each.

These facts and statements sufficiently shew the necessity of some regulation being speedily adopted of adjusting weights and measures to some simple standard, both in this and the northern parts of the kingdom.

The table of weights constructed by Lord Somerville, and introduced below, may be useful to the flock-farmer and grazier in most situations.

Table for the Equalization of different Weights.

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Weight,
WEIGHT, Pondus, in Mechanics, is anything that is raised, lifted, or moved by a machine; or any thing that in any manner refills the motion to be produced. See Motion, &c.

In all machines, there is a natural ratio between the weight and the moving power. If the weight be increased, the power must be so too; that is, the wheels, &c. are to be multiplied, and so the time increased, or the velocity diminished.

"The centre of gravity F, (Plate XL, Mechanics, fig. 6.) of a body I H, together with the weight of the body, being given; to determine the point M, in which, lying on a horizontal plane, a given weight G, hung in L, cannot remove the body I H out of its horizontal situation."

Conceive a weight hung in the centre of gravity F, equal to the weight of the whole body I H, and find the common centre of gravity M, of that and the given weight G. If the point M be laid on the horizontal plane, the weight G will not be able to move the body H I out of its place.

"The centre of gravity C (fig. 7.) of a body A B, together with its weight G, being given; to determine the points L and M, wherein props M N and L O are to be placed, that each may bear any given proportion of the weight."

In the horizontal line A B, passing through the centre of gravity C, assume the right lines M C and C L in the given ratio. Props, then, M N and L O, placed in these points, will be prefed in the given ratio.

Hence, if in the points M, L, in lieu of props, you place the shoulders or arms of porters, &c. they will be able to bear the burden alike; if their shares be proportioned to their strengths. Thus we have a way of distributing a burden in any given ratio.

Weights, Gros, Neat, Penny, Assay of, Ancel. See the several articles.

Weight of the Atmosphere. See Atmosphere.

Weight of the Air, is equal to the nullity thereof. To find the Weight of a Cubic Inch of Air.—Weigh a round glass vessel full of common air, very accurately; then exhaust the air out of it; weigh the exhausted vessel, and subtract the latter weight from the former, the remainder is the weight of the air exhausted.

Find, then, the content of the vessel by the laws of measuring; and the ratio of the remaining air to the primitive air. This done, the bulk of the remaining air is found by the rule of three; which being subtracted from the capacity of the vessel, the remainder will be the bulk of air extracted. Or, if the air-pump be very tight, and the exhaustion continued as long as any air is got out, the remaining air will be so small, that it may be very safely neglected, and the content of the vessel taken for the bulk of the exhausted air.

Having, therefore, the weight and bulk of the whole exhausted air, the weight of one cubic inch is easily had by the rule of three.

This method was first used by Otto Guericke, and afterwards by Burcher de Volder, who gives us the following particulars in his experiment. 1. That the weight of the glasses spherical vessel he made of, full of common air, was 7 lbs. 1 oz. 2 drs. 48 grs.; when exhausted of air, 7 lbs. 1 oz. 1 dr. 31 grs.; and when full of water, 16 lbs. 12 oz. 7 drs. 14 grs. 2. The weight of the air, therefore, was 1 dr. 17 grs. or 77 grs.; the weight of the water 9 lbs. 11 oz. 5 drs. 43 grs. or 74743 grs. Consequentially, the ratio of the specific gravity between water and air is 74743 : 77 :: 9705 : 1. Now, De Volder having found a cubic foot of water to weigh 64 lbs., by inferring, as 970 is to 1, so is 64 lbs. to a fourth proportional, deduced by the rule of three, the weight of a cubic foot of air, viz. 1 oz. 27 grs. or 507 grs. nearly. Wolfii Elem. tom. ii. p. 291.

From other later experiments accurately made with the hydrostatical balance, a cubic inch of air appears to be equal to two-fourths of a grain, and therefore a cubic foot equal to 4315/36 troy grains. There are various ways of estimating the weight of the air; for which, see Air, Atmosphere, Barometer, Specific Gravity, &c.

It may be easily determined by fitting a brass cap, with a valve tied over it, to the mouth of a thin bottle or Florence flask, whole contents are exactly known, and screwing the neck of this cap into the hole of the plate of the air-pump; then, having exhausted the flask of its air and taken it off from the pump, fulfill it at one end of a balance, and nicely counterpoise it by weights in the scale at the other end: when this is done, raise the valve with a pin, and the air will rush into the flask, and cause it to descend. When it is full of air, put grains into the scale at the other end to redore the equilibrium; and if the flask holds exactly a quart, it will be found, that 17 grs. will be sufficient for this purpose, when the quicksilver stands at 295/3 inches in the barometer; and this shews, that when the air is at a mean ratio of density, a quart of it weigh 17 grs.; and consequently a gallon weighs 68 grs.; i.e. 231 cubic inches of air are equal in weight to 68 grs., and 1728 cubic inches, or a cubic foot of air, weighs 507 5/6 grs.; and as a cubic foot of water weighs about 337502 troy grains, the specific gravity of water will appear to be more than 850 times that of air. See Air.

The weight of sea-water is different in different climates. Mr. Boyle having furnished a learned physician, going on a voyage to America, with an hydrostatical balance, and recommended him to observe, from time to time, the difference of weight he might meet withal; this account was returned him: that the sea-water increased in weight, the nearer he came to the line, till he arrived at a certain degree of latitude, as he remembers, about the 40th; beyond which, it retained the same specific weight, till it came to Barbadoes. Philof. Trans. N° 18.

The weight of a cubical inch of good brandy, rum, or other proof spirits, is 235.7 grs.; therefore, if a true inch cube of any metal weighs 235.7 grs. less in spirits than in air, it shews the spirits are proof; if it looses less of its aerial weight in spirits, they are above proof; if it looses more, they are under: for the better the spirits are, they are the lighter; and the worse, the heavier.

As all bodies expand with heat and contract with cold, in different degrees, the specific gravities of bodies are not precisely the same in summer as in winter. It has been found, that a cubic inch of good brandy is 10 grs. heavier in winter than in summer; as much spirit of nitre, 20 grs.; vinegar, 6 grs.; and spring-water, 3 grs. Hence it is most profitable to buy spirits in winter, and sell them in summer, since they are always bought and sold by measure. It has been found, that 32 gallons of spirits in winter will make 33 in summer. Ferguson’s Lect. p. 98. 4to. See Specific Gravity, and Hydrometer.

Weight of the Human Body. It is to be observed, that the heat and dryness of the air both lessen the weight of the body, and the cold and moisture of the air both increase this weight. See Moisture.

Much sleep, much food, and little exercise, are the principal things which increase the weight of the body, and make animals grow fat. Consequentially, if the weight of the body be too great for good and uninterrupted health, it may be lessened by diminishing sleep and food, and by increasing
increasing exercise. On the contrary, if the weight of the body be too little for good health, it may be increased by adding to food and sleep, and by lessening exercise; and the food must be increased chiefly by increasing drink and liquid nourishment. For the discharges are commonly lefts from drink and liquid nourishment, than from dry and solid food.

There is but one weight under which a body can enjoy the best and uninterrupted health, and that weight must be such, that perspiration and urine may be nearly equal at all seasons of the year; for by this means the body will be uniformly drained of its moisture; the inward parts by urine, and the more superficial parts by perspiration, without any irregular and unnatural discharges, and its moving weight will continue nearly the same at all seasons of the year. Dr. Bryan Robinson thinks this weight may be settled by his observations in his Treatise on Food and Discharges of Human Bodies.

A quick increase of weight in human bodies often produces ditempers; the best way to prevent this increase is either by fasting or exercise. But amidst a variety of disturbing causes, nothing so effectually prevents such an increase of weight as a very exact and regular diet, which may prevent the discharges from running into irregularities and disproportions to one another. See Dr. Bryan Robinson of the Food and Discharges of Human Bodies, p. 82. seq.

Men, and other animals of extraordinary weight, are often recorded in the writings of the learned. See Phil. Trans. No. 479, p. 102.

Wight, Athletic, in the Animal Economy, that weight of the body under which an animal has the greatest strength and activity. Dr. Robinson thinks this happens when the weight of the heart, and the proportion of the weight of the heart to the weight of the body, are greatest. For the strength of an animal is measured by the strength of its muscles, and the strength of the muscles is measured by the strength of the heart. Also the activity of an animal is measured by the weight of the heart, in proportion to the weight of the body.

If the weight of the body of an animal be greater than its athletic weight, it may be reduced to that weight by evacuations, dry food, and exercise. These lessen the weight of the body by wasting its fat, and lessening its liver, and they increase the weight of the heart, by increasing the quantity and motion of the blood; so that by lessening the weight of the body, and by increasing that of the heart, they will soon reduce the animal to its athletic weight. Thus a game cock, in ten days, is reduced to its athletic weight, and prepared for fighting. If the food which, with the evacuations and exercise, reduced the cock to its athletic weight in ten days, be continued any longer, the cock will lose his strength and activity.

It is known by experience, that a cock cannot stand above twenty-four hours at his athletic weight, and that he has even changed for the worse in twelve hours. When he is in the best condition, his head is of a glowing red colour, his neck thick, and his thigh thick and firm; the day after, his complexion is less glowing, his neck thinner, and his thigh softer; and the third day his thigh will be very soft and flaccid. Four game cocks, reduced to their athletic weight, were killed, and found to be very full of blood, with large hearts, large muscles, and no fat.

It is to be observed, that the athletic weight of an animal is a very dangerous weight. Fevers and apoplexies are the disorders which commonly happen to animals under or near the athletic weights. Hence, horses fed upon dry food are much more subject to fevers and apoplexies than horses fed upon grapes. Robinson's Dissertation, p. 117, &c.

Wight. Sessions for. See Session.

Weight, Live and Dead, of Animals, in Agriculture and Rural Economy, the differences between their living and dead weights as affecting their goodnes and value for the purpose of the breeder and feeder or fattener. But few correct trials have yet been made in the view of determining this very important point or particular. It would seem, however, from the little that has been done on the subject, that those forts of live-flock that have the best forms, and the leaf weight in the different offal parts, are the most valuable and beneficial to the flock master and farmer.

In neat cattle flock the difference or loss in this way is somewhere about a fourth, but the mole in those breeds which are the leaf correct in their forms or shapes. In some unimproved breeds it has been found a good deal more, while in those which have been greatly improved rather less. In calves it will mostly be from a third to a fourth.

In the good Herefords, and some of the best long horn or Lancashire forts, these proportions have been found on trial to be very nearly correct, both in the grown beaux and the calves.

In sheep flock, too, the same principle, for the moit part, holds good, those having the least difference or loss in this way that are the best in their forms.

In trials with the South Down breed of sheep, as stated in the Corrected Report on the Agriculture of the County of Suffex, the proportions of the live and dead weight are these:

<table>
<thead>
<tr>
<th>Live weight of the sheep</th>
<th>Dead weight next day of carcass</th>
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<tbody>
<tr>
<td>192 lbs.</td>
<td>125 lbs.</td>
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</table>

Weight of Offal.

<table>
<thead>
<tr>
<th>Blood</th>
<th>6 lbs.</th>
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</thead>
<tbody>
<tr>
<td>Entrails</td>
<td>11 lbs.</td>
</tr>
<tr>
<td>Caull</td>
<td>16 lbs.</td>
</tr>
<tr>
<td>Gut fat</td>
<td>5 lbs.</td>
</tr>
<tr>
<td>Head and pluck</td>
<td>8 lbs.</td>
</tr>
<tr>
<td>Pelt</td>
<td>15 lbs.</td>
</tr>
</tbody>
</table>

In an average specimen of a wether of the same breed:

| Live weight of the sheep | 133 lbs. |
| Dead weight the day after | 73 lbs. |

Weight of Offal.

<table>
<thead>
<tr>
<th>Blood</th>
<th>4 lbs.</th>
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<tbody>
<tr>
<td>Tallow</td>
<td>10 lbs.</td>
</tr>
<tr>
<td>Entrails</td>
<td>14 lbs.</td>
</tr>
<tr>
<td>Skin and feet</td>
<td>16 lbs.</td>
</tr>
<tr>
<td>Head and pluck</td>
<td>9 lbs.</td>
</tr>
</tbody>
</table>

In one of general Murray's breed of the same kind:

| Live weight | 129 lbs. |
| Dead weight | 62 lbs.  |

Weight of Offal.

| Tallow | 6 lbs. |

It is remarked that the lightness of the offal, such as the head, horns, feet, entrails, pluck, blood, pelt, &c. is the circumstance which characterizes a good sheep; and it is said,
said, that Dihley wethers well fattened are in the proportion of one ounce of bone to a pound of flesh.

That the offal, in the fat wether of the South Down breed first flated, was but a fifth part and a fraction of the live weight, as below:

<table>
<thead>
<tr>
<th>Component</th>
<th>lbs</th>
<th>oz</th>
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<tbody>
<tr>
<td>Offal</td>
<td>42</td>
<td>0</td>
</tr>
<tr>
<td>Carcase</td>
<td>125</td>
<td>0</td>
</tr>
<tr>
<td>Fat</td>
<td>21</td>
<td>4</td>
</tr>
<tr>
<td>Loaf by killing</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>192</td>
<td>0</td>
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Some useful information, which has a tendency to elucidate the point concerning the proportion between the live and dead weight of some different breeds of sheep, has been given under the head sheep. See SHEEP, PELT, and TALLOW.

In good pig flock the difference in the proportion between the live and dead weight of the animals, or the losses of weight that is sustained by the farmer, will be found probably to be rather less than a fourth in the better breeds, and rather more than that in those which are inferior in their qualities. The best breeds of pigs have by much the least losses in this way, and they have advantages in other respects. See SWINE.

These facts and standings tend to show the advantages which the farmer has in keeping good live-flock of all kinds.

WEIGHTON, Market, in Geography, a small market-town in the Holme-beacon division of Harthill wapentake, East Riding of the county of York, England, is situated on a little river called Foulnefs, in the high road between York and Hull, at the distance of 19 miles E.S.E. from York, and 192 miles N. by W. from London. Some antiquaries considered this place the Roman station, Dolgovitia, till Drake, with great appearance of probability, ascribed that station to the village of Loundshire, nearly three miles north of Weighton. This town consists of one long street, intersected by a few smaller; till within the last thirty years, the houses were in general low and mean, and covered with thatch; but since that period, a number of respectable buildings have been erected, and considerable improvements have been made. A weekly market is held on Wednesdays, when a great quantity of corn is often sold, though but little is exposed, being chiefly disposed of by sample. Two fairs are held annually for horses, cattle, and particularly for sheep, and cheese. The trade of the town has been considerably increased by means of a canal from the Humber; whereby coals and other articles are brought hither, and the barges return laden with grain. By the population return of the year 1811, the inhabitants of this town are enumerated at 1508; the number of houses as 239. The church is an ancient massive edifice; it formerly had a wooden spire, which has been recently taken down, and a considerable addition made to the height of the tower; the interior of the church has also been greatly improved, and furnished with an additional gallery. A meeting-house for Methodists has lately been erected. There is no endowed school in the parish. About two miles east of Weighton is the brow of the Yorkshire wolds, whence very extensive views are obtained.—Beauties of England and Wales, vol. xvi. Yorkshire, by J. Bigland, 1812. Drake's Eboracum, or the History and Antiquities of York, fol. 1736. Vol. XXXVIII.
WEINHEIM, a town of the duchy of Baden, situated in the Bergstrasse, and famous for its wine. The Roman Catholics, the Lutherans, and the Calvinists, have each a church; 9 miles N. of Heidelberg.

WEINITZ, or VINTZA, a town of the duchy of Carniola, on the Kulp; 10 miles E.N.E. of Gottchee.

WEINMANNIA, in Botany, a name which seems to have originated with Dr. Patrick Browne, who, without due attention, called it Windmanna. The person whom he designed to commemorate was John William Weinmann, an apothecary of Ratibon, author of a huge botanical German work, entitled Phytanthoza Iconographia, consisting of four thick folios, with 1025 large coloured engravings of plants. The first volume appeared in 1737, the last in 1745, after the author's decease. There is a preface to the latter by Haller. Dieterich and Bieler contributed part of the text, and there are ample indexes, in various languages. The plates are rude, and gloomily coloured. Trew, whose candour nevertheles is allowed by Haller, says, "varieties are not distinguish'd," in this work, "from species, the structure of the flowers is scarcely expressed, nor was the author competent to refer his plants to their true genera." Burmann began a Dutch edition, with some additions, in 1736. The book is necessarily expensive, on account of its bulk, and is rare in England. We have seldom had occasion to consult it, nor have we ever done so without disappointment.—Linna. Gen. 195. Schreb. 263. Wildl. Sp. Pl. v. 2. 436. Mart. Mill. Dict. v. 4. Juff. 309. Poiret in Lamarck Dict. v. 7. 578. Lamarck Illustr. t. 313. (Windmanna; Browne Jam. 212.) —Clas and order, Oidaria Dignia. Nat. Ord. akin to Saxifragae, Juff.; or rather, we should think, as he himself hints, to his Rhododendra.

Gen. Ch. Cal. Perianth inferior, of four ovate, spreading, permanent leaves. Cor. Petals four, equal, undivided, longer than the calyx. Nectary glandular, surrounding the base of the germen. Stam. Filaments eight, erect, thread-shaped, longer than the petals; anthers roundish, of two cells. Fil. Germen superior, ovate, acute; styles two, somewhat spreading, the length of the stamens, permanent; stigmas obtuse. Peric. Capsule elliptic-oblong, with two points, two cells, and two valves, whose inflexed margins form the double partitions. Seeds about eight in each cell, roundish.

Eff. Ch. Calyx of four leaves. Petals four. Capsule superior, with two beaks, two cells, and two valves with inflexed margins. Seeds several.

A very handsome genus of extra-European shrubs, with opposite, compound or simple leaves, accompanied by interfoliaceous deciduous stipulas. The flowers are small, copious, racemose, rarely panicked. Capsules permanent long after the seeds are fled. Cunonia, (see that article,) appears to differ from this genus, merely by adding one-fifth to the parts of fructification, which in this cafe is of no avail whatever.

Sec. 1. Leaves compound.

1. W. glabra. Smooth Pinnate Weinmannia. Linn. Suppl. 228. Wildl. n. 1. Swartz Obs. 151. (W. pinata; Linn. Sp. Pl. 515, excluding the reference to Browne.) —Leaves pinnate; leaflets obovate, crenate, smooth on both sides. Capsule roundish-elliptical, bluntish.—Native of the West Indies. The stem, usually shrubby, sometimes becomes a tree, forty feet high, with round, rugged branches; when young angular, and coarsely downy. Leaves of six pair, more or less, with an odd one, of obovate, abrupt leaflets, half an inch at most in length, all nearly equal, furnished with one rib and several transverse veins; entire and wedge-shaped towards the base. Common footstalk jointed, each articulation, between the leaflets, winged with a leafy rhomboid expansion, tapering most downward, and hairy at each end. Clusters opposite, at the end of each branch, on hairy axillary stalks, dense, about an inch long when in flower; twice as long, and much more lax, when in fruit. Flowers very small, white, on falciculated, short, thick, hairy partial stalks. Capsules about half the size of hempseed, brown; their stalks elongated; their valves obtuse, tipped with the styles, and, as they ripen, turning their pale narrow edges, which had formed the partitions, outwards. Permanent styles mostly recurved, rather shorter than the valves. We have not seen the seeds.

2. W. tinctoria. Red-tan Weinmannia. (Weinmannia; Lamark t. 313. f. 1. Tan-rouge; Commerson MSS.) —Leaves pinnate; leaflets elliptical, crenate, smooth on both sides. Capsule ovato-lanceolate, taper-pointed. Seeds hairy.—Gathered by Commerson in the Isle of Bourbon, where it is known by the name of Tan-rouge, because the bark serves to dye leather of a red color. The flowers are supposed to furnish the bees with much of their honey. French botanists appear to have confounded this plant with the preceding. It is certainly what Lamarck has figured, and what Poiret has quoted, for W. glabra, the latter having taken Tan-rouge from hence, for his French generic name of the whole genus, though without advertiting to its use in the Isle of Bourbon, or its being a native of that country. The leaves are full twice the size of W. glabra, with elliptical, not obovate, leaflets: wings of their footstalk similar to the last. Clusters of flowers much more lax, and less hairy, three or four inches long; the flowers twice as large. Capsules of a very different shape, and paler redder hue, tapering into the straight erect styles, which are not a quarter so long as the valves, nor are the edges of the latter ever turned outward, or flattened. The clusters of ripe capsules are cylindrical, dense, four or five inches in length. Seeds clothed with a few long prominent hairs.

3. W. birta. Hairy-leaved Weinmannia, or Baftard Brachiletto. Swartz Ind. Occ. 691. Wildl. n. 2. Poiret in Lam. n. 3.—Leaves pinnate; leaflets elliptic-ovate, crenate, hairy at the back. Capsules oblong.—Native of lofty mountains in the south part of Jamaica, in St. Andrew's parish, near Coldspring, the residence of Matthew Wallen, esq. (See Wallenia.) This, according to Dr. Swartz, from whom we have a specimen, is a very rare species. It is either a shrub, or a hardy tree, from forty to fifty feet high, crowned at the very top of its smooth trunk with lax, hairy, or somewhat downy, rusdy-coloured branches. The leaves most resemble the leaf in shape, but are clothed beneath, sometimes on both sides, with coarse, flattered, prominent hairs. The leafy borders of each joint of the common footstalk are narrower, and less angular, than those of our first or second species, and their midrib is very hairy beneath. Clusters also very hairy, an inch or two in length, in pairs at the summits of the branches. Flowers the size of the leaf, white. Capsule, according to Swartz, small, oblong, rather pointed, with several small roundish seeds. This tree flowers in September and October. Some specimens, in the herbarium of the younger Linnaeus, excite a doubt whether the hairines of the foliage may invariably be relied on. Still we have no doubt of the distinctness of these three species. The third is perhaps most allied to the second, which appears to be what Dr. Swartz saw marked W. arborea, and which Commerson was said to have gathered in the Isle of Mauritius. We do not at all comprehend how the joints of the common footstalk can be termed "somewhat heart-shaped," in W. birta; they are rather more truly obo-
vate than in either of the foregoing, being less angular, or deltoïd.

4. W. trichophyllum. Hairy-feeded Weinmannia. Cavan. Ic. v. 6. 45(' t. 567. Poiret n. 2.—Leaves pinnate; leaflets elliptic-oblong, serrate, smooth on both sides. Caplule roundish-elliptical. Seeds denile hairy.—Gathered by Louis Née, at San Carlos, in Chili, bearing ripe capsules in February. Cavanilles. By the plate above quoted, this bears most resemblance to the first species, especially in the acute angles of the deltoid articulations of the footstalks, which in all the other species are rounded. But the leaflets are longer and more elliptical, serrate rather than crenate; the capsules broadly elliptical, not obtuse, their inflexed edges, if the figure be accurate, much broader, and containing inflexed. The seeds are roundish-kidneyshaped, clothed with long, copious, projecting hairs, of which no mention is made by any botanist who has described the seeds of W. glabra or W. birta, and therefore we must presume they do not exist in those species. We find such hairs, very sparingly, on the globular seeds of W. tinctoria, but the capsules of that species are abundantly different from the present.

5. W. tomentosa. Woolly Weinmannia. Linn. Suppl. 227. Wildd. n. 3. Poiret n. 4.—Leaves pinnate; leaflets elliptical, revolute, entire, woolly beneath.—Gathered in New Granada, by Mutis. A very distinct and remarkable species. The branches are woody, round, densely leafy, rough, somewhat warty, of a brown dark; hoary and downy when young. Leaves hardly an inch and a half long; leaflets about five pair, with an odd one, each one-third of an inch in length, convex, slightly hairy, single-rubied; the under side clothed with cupious, loose, hoary, woolly hairs. The joints of the common footstalk are rather shorter than the leaflets, obovate, not angular; their edges revolute, and the under side woolly. Stipulas large, ovate, reflexed, coloured, hairy externally, deciduous. Flowers in very dense clusters, rather above an inch long, on thick, short, woolly, axillary flasks. Calyx hairy. Capsules wanting in our specimens.

6. W. trifoliata. Three-leaved Weinmannia. Linn. Suppl. 227. Thunb. Prodr. 77. Wildd. n. 4. Poiret n. 5. Lamarck f. 2.—Leaves ternate; leaflets obovate, crenate, smooth.—Gathered by Thunberg, at the Cape of Good Hope. The whole plant is said to be very smooth. Leaflets equal, about an inch long, being about two-thirds the length of their common footstalk, which is simple and naked. Clusters cylindrical, dense, two or three inches long, on axillary flasks about half their own length. The germs in Lamarck's figure is roundish and hairy. We have seen no specimen, nor is there any account of the capsules or seeds.

Seft. 2. Leaves simple.

7. W. racemosa. Smooth-clustered Simple-leaved Weinmannia. Linn. Suppl. 227. Wildd. n. 5. Forst. Prodr. 27. Poiret n. 580.—Leaves simple, stalked, ovate, with tooth-like serratures. Clusters axillary, solitary, nearly smooth.—Gathered by Forster, as well as by Menzies, in New Zealand. The branches are stout, woolly, repeatedly branched in an opposite manner, round and rough. Footstalks stout, smooth, half an inch long, articulated at the summit with the leaf, which is two, or two and a half, inches long, and one broad, pointed, rarely coriaceous, quite smooth, strongly veined, beft with blunt, inflexed, wavy teeth, or serratures; paler beneath. Clusters about the tops of the branches, though axillary, stalked, longer than the leaves, cylindrical, continuous; their general and partial flasks either slightly downy, or quite smooth. Capsules obovate, pointed, some-

what downy; the inflexed edges of their valves finally expanded. We cannot find a seed in any of our specimens.

8. W. parviflora. Small-flowered Weinmannia. Forst. Prodr. 29. Wildd. n. 6. Poiret n. 7.—"Leaves, simple, nearly sessile, ovate, pointed, with tooth-like serratures. Clusters terminal, aggregate, hairy."—Native of Otahutate. Forster. Willdenow, who had seen a dried specimen, describes the flowers as hairy when young. Leaves on short flanks, oblong, smooth on both sides. Clusters downy, from three to five at the top of each branch, forming a sort of panicule. Flowers but a quarter the size of the preceding.

9. W. ovata. Ovate-Crenate Weinmannia. Cavan. Ic. v. 6. 45 t. 566. Poiret n. 9.—Leaves simple, elliptical, crenate, smooth at each end, on short flanks. Clusters axillary, solitary, opposite, somewhat downy.—Native of Peru, in a large alluvial excavation, near the town of St. Buenaventura, flowering in June and July. This is a tree eighteen feet high, with furrowed, rather knotty branches, thickened at the infection of the leaves, which seem very like those of W. racemosa in shape, size, veins, and smoothness, but are more truly crenate, and frond on shorter footstalks. Clusters opposite, at the tops of the branches, though axillary and solitary, each two or three inches long; their partial flasks aggregate, and somewhat villous. Nothing is known of the capsule or seeds. We could wish for better materials than Cavanilles affords us, for distinguishing this species from the racemosa, n. 7.

10. W. paniculata. Panicled Weinmannia. Cavan. Ic. v. 6. 44 t. 565. Poiret n. 8.—Leaves simple, elliptic-lanceolate, sharply serrated. Panicules axillary, compound.—Gathered by Louis Née, at the sea-shore near Talcahuano, in Chili, flowering in February. A tree about the stature of the last, but the leaves are longer, more lanceolate, with parallel veins, and copious branched serratures, which give them some resemblance to the sweet-chestnut leaf. They are smooth, and frond on short downy footstalks. The panicled inflorescence is singular among all the known species. Flowers yellowish-red. Capsules elliptical, acute, downy, beaked with the straight styles, which are as long as the valves. Seeds obovate, smooth, on slender flanks, pendulous. We have a specimen from the late abbé Cavanilles.

WEINSBERG, in Geography, a town of Wurtemburg; a part of which is built on a round hill, on which lies a ruined castle: the other part lies in a valley. In it is a special superintendency. The valley in which it lies is famous for wine; 5 miles N.E. of Heilbronn.

WEINSTEIG, a town of Austria; 8 miles N. of Korn Neuburg.

WEINZIEL, a town of Austria; 8 miles S.E. of Ipa.

WEIPERSHOFEN, a town of the principality of Anspach; 5 miles S.E. of Crelheim.

WEIPERT, a town of Bohemia, in the circle of Saaz; 14 miles W. of Commotan.

WEIR, one of the smaller Orkney islands, containing about 67 inhabitants. It had formerly a church, which is now in ruins; 2 miles S. of Ronaf.

WEIR, or WEAR, in Rural Economy, a sort of dam, bulwark, or strong erection, formed across a brook, rivulet, stream, river, main, or any such water-course, for the purpose of diverting or turning the water, in watering land. It is occasionally made in different ways, as of timber alone, sometimes of bricks, or stones, and timber, and of different other materials, as will be found below, having from two to eight or ten thoroughs or openings for letting the water pass through, according as the breadth of the stream
flood and other circumstances may be. The height of it is always equal to the depth of the stream compared with the adjacent land.

The water of a very small and gentle stream may often be diverted for this use, by means of a few fods firmly put down, with some stones above them: but for lands of any considerable extent, the kinds directed below are necessary, according as the strength of the respective streams may happen to be.

Strong wooden beams or balks thrown across the stream, and made close by means of boards well secured, are, in many cases, sufficiently strong, commodious, and convenient, in flow moving waters, of no great power or force.

A few cart-loads of stones thrown properly in across the stream, forms also a bulwark, wide at the base, and narrowing towards the top, the whole being paved with clay or gravelly earth, which sometimes answers well. Over the top of this bulwark, the superluous waters pass in a free manner, falling down the gentle slope, to which, if well constructed, they do no sort of injury.

A weir suitable for a small river may consist of several rows of flates, firmly driven down and interlaced with the branches of fir-trees, the intervals of the rows being filled with stones. The sand and mud that come down with the floods fill up this fort of weir, and render it fit for effecting its purpose. In heavy rains the superluous water piles entirely over.

But for more powerful rivers, the weirs may be constructed of strong frame-works of wood, firmly and strongly joined together, and the different compartments all paved with large stones: the weir rising very gradually against the stream, and being made to slope gradually away before it, as it flows over it. In this way the largest and most powerful rivers may molly be managed, if the weirs be well suited to them; so that it is but in few cases advisable to attempt the watering lands from rivers that cannot be diverted by one or other of these sorts of weirs, as the expense and hazard taken together may greatly exceed the advantage to be derived. It may, however, in some cases of large rivers, be necessary and proper to have recourse to more expensive weirs, such as that described below.

In this weir, which was formed on a large, rapid, and strong river, under the direction of the Rev. W. H. Cogham, in Devonshire, after the stream had been temporarily diverted, and every thing removed for a proper foundation, a double row of pits was dug into a rocky substratum, directly across the bottom, or bed of the river, at about five feet aunder lengthways, by four feet in breadth, and about two feet in depth; and into these pits oak planks of about six or seven inches square were fixed. The mason then raised a perpendicular wall, without any cement, about five feet and a half thick, entirely enclosing the pits, the labourers being employed in the mean time in backing up the wall on the higher side with some of the flithe clay to be had. This was, however, afterwards found to be wrong; it should have been done in the puddle manner, by means of mould and gravelly earth.

When the wall was raised to such a height as was deemed necessary, in relation to the level required, and the preservation of the lands adjacent, the upper parts of the oak planks were worn off, in order to receive cross-pieces and joints, the front planks being then left to stand about six inches higher than the hinder ones; and on these joints oak planks were pinned, about fix feet and a half long by three inches thick. These planks were brought forward to project about one foot and a half over the perpendicular of the wall, on the lower side, forming a port of lip, as it has been termed; the clay, together with these planks, constituting an inclined plane, and terminating at the distance of about fifteen feet up the stream, on the common bed of the river.

The entrance for the leat was cut at about thirty feet above the lip of the weir, where, to regulate the quantity of water to be admitted, three strong flood-hatches, to be lifted or let down by a lever and windlass, were placed; and through which a column of water, of about eight feet in width by four feet in depth, may be introduced at any time. Between the leat and the river a stone wall, strongly cemented, is erected, which is about eight feet in height, and carried from the head of the leat to about thirty feet below the weir, in a parallel line with the river, and at the end of which wall another flood-hatch is fixed on a level with the bed of the river. This latter hatch will always be of great advantage when any reparations may be wanting on the weir; as on drawing it up when the water is low, the weir in a few hours will be left perfectly dry, and the workmen, with the greatest convenience, may proceed in their operations. From the top of the side wall, above the weir, the ground is made sloping to the river, and below it is covered with turf, and levelled as a foot-path.

Immediately below the weir, in this case, there is an outlet regulated by another flood-hatch, and conducted through a foot formed of oak plank, from the leat, and contrived for the admission of salmon, which are there sometimes taken; and below the lower flood-hatch, a trap, or culvert, as it is there termed, is made for the catching of smaller fish: this part of the work does not, however, properly belong to this kind of weir, therefore it need not be more noticed.

The height of the weir is about four feet above the level of the river where it is fixed; and its length, from bank to bank, directly across, or at right angles with the stream, is about forty-eight feet; forty feet of which is carried at a perfect level, and over which the water falls precisely at the same depth, forming a beautiful cascade. The remaining portions of the length of the weir, namely, four feet on each side, are raised, gradually ascending to the banks for the purpose of warding off the torrent from them in time of floods, when the river, in this case, is very tumultuous.

The lip part of the weir is found to answer perfectly; as in proportion to the force of the water behind, so is the distance which it is thrown over the weir from the foundation of the perpendicular wall.

If the writer had not been foiled, and had part of the work to perform over again, in consequence of the use of clay, as already noticed, being under the necessity of driving on the weir in a direct line with the former work, into the side of the opposite bank, as before; and after removing as much of the clay as could be got at, which will not unite completely with the soil, but become liable to be undermined by the water, by making a puddle, as used in canals of mould and gravel, in its head, which succeeded in a complete manner; the whole cull of the weir would not have exceeded 7s.

This weir or weir, from its present appearances, may now, it is said, seem to bid defiance to time; and be safely recommended as a pattern to those who may have occasion to construct any thing of a similar kind, either for watering land, for machinery, or other uses. See Watering Land.

In the weirs or weirs which are thrown over large rivers for the purpose of raising the water for the use of mills, and in many other intentions, and which are mostly constructed of
of stone, with strong framed wood-work, in somewhat the above manner, there are many different contrivances calculated for different uses, such as locks for securing large ships, places for taking and preferring those of the smaller forts, and different others. See Dr. Anderdon’s Treatise on the Erection of Weirs, and a full explanation of the principles and manner of constructing them will be found.

WEIS See in Geography, a lake of the duchy of Carinthia; 10 miles N.W. of Velach.

WEISA, a town of Saxony, in the circle of Erzgebirg; 3 miles S.S.W. of Wolkenstein.

WEISBRODN. See VESMIN.

WEISCHE OFFA, a river of Silezia, which runs N.E. into the Schwarze Oppa.

WEISCHENFELD, a town of Bavaria, in the bishopric of Bamberg; 18 miles E.S.E. of Bamberg. N. lat. 49° 45’. E. long. 11° 19’.

WEISDORF, a town of Germany, in the principality of Cumbachs; 3 miles E. of Munich.

WEISEN, a town of Prussia, in the province of Oberland; 10 miles W.S.W. of Leipzic.

WEISENBAD, a town of Saxony, in the circle of Erzgebirg; 3 miles S.S.E. of Wolkenstein.

WEISENBERG, a township of Pennsylvania; 60 miles N. of Philadelphia.

WEISENBERG, or WEISSENBACH, a town of Lusatia; 8 miles E. of Budiffen. N. lat. 51° 12’. E. long. 14° 45’.

WEISENBRUN, a town of Bavaria, in the bishopric of Bamberg; 24 miles S. of Cracow.

WEISENBURG, a town of Austria; 12 miles S.S.W. of St. Polten.

WEISENBERG. See WEISSENBURG.

WEISENBORN, a town of the duchy of Baden, situated in a county to which it gives name, on the Rot; 11 miles S.E. of Ulm. N. lat. 48° 17’. E. long. 10° 8’.

WEISENKIRCHEN, a town of Austria; 11 miles S.W. of Tulln.

WEISFURT, a river of Silezia, which runs into the Oder, 3 miles below Beuthen.

WEISKIRCH, a town of Bohemia, in the circle of Bohemia; 3 miles S.S.E. of Krottou.

WEISKIRCHEN, or WEISKIRCHEN, a town of Moravia, in the circle of Prerow; 15 miles E.N.E. of Prerow. N. lat. 49° 30’. E. long. 17° 43’.

WEISMAYN, a town of Bavaria, in the bishopric of Bamberg; 20 miles N.E. of Bamberg. N. lat. 50° 6’. E. long. 11° 18’.

WEISSE, Christian-Felix, in Biography, a German poet, was born in 1726, in Annaberg, in Saxony, and educated, first at the Gymnasium of Altenburg, and afterwards at Leipzic. The objects to which his talent most powerfully inclined him were poetry and the drama; and he and his friend Lessing concurred in translating for the stage from French and English works, and afterwards in furnishing original compositions. He also contended with his friend in lyric poetry. After completing his course of education, he became private tutor in a family of distinution at Leipzic, pursuing his dramatic and poetical career, and gaining a great degree of popularity. He also edited the Bibliotheca of Belles Lettres, when Nicolai surrendered it. Although, in 1761, he obtained a place in the revenue at Leipzic, he prosecuted his employment as a writer for the stage; and when he became the father of a family, he directed his attention to education, and published several pieces in this department: particularly, in 1772, a collection of short tales and moral maxims, which had a consider-

able circulation; and in 1775 he revived a weekly publication, which Adelung had discontinued, under the title of the “Children’s Friend.” This work became afterwards a quarterly publication, and between the years 1775 and 1782, passed through five editions. From this popular work Berquin derived the idea of his “Ami des Enfants,” and he was indebted to it for many of his materials. As Weisse’s children grew to maturity and settled in the world, he altered the plan of his work, and continued it under the form of Letters; and Berquin also followed him in his “Ami des Adolecentes.” In 1790 the beautiful edifice of Storteritz near Leipzic, which Weisse inherited, placed his family in affluent circumstances, and furnished him with a pleasant residence. Towards the latter part of his life he contributed short fables and poetical tales to journals and periodical publications, which were well received, and at length closed his life with reputation, in December 1804. His dramatic works, which were continued to five volumes, are said to have formed an epoch in the history of the German stage, and both his translations and original compositions were well received. Gen. Biog.

WEISSE, in Geography, a river of Prussia, which runs into the Rufa, 20 miles N.W. of Tilsit.

WEISSENBURG, a town of Prussia, in the county of Oberland; 5 miles S. of Marienwerder.

WEISSELMUNDA. See VESCHISELMUNDA.

WEISSENBURG, or KORN WEISSENBURG, or WIESENBURG, a town of France, and principal place of a district in the department of the Lower Rhine, situated on the Lauter, at the foot of the Vogers. This town was formerly imperial, and was ceded to France by the peace of Rylwick. The fortifications were destroyed by Louis XIV.; but strong lines of defence are fixed from this town to the Rhine, a little to the east of Lauterburg, on the S. side of the Lauter; 27 miles N. of Strauburg. N. lat. 49° 3’. E. long. 8’.

WEISSENBURG, a town of Bavaria, called WIESENBURG near the Nordgau. It contains two churches and a medicinal spring. Weissemburg was an imperial town, till in 1802 it was given to the elector of Bavaria; 28 miles S.S.W. of Nuremberg. N. lat. 48° 58’. E. long. 10° 54’.

WEISSENBURG, or Alba Julia, or SARLENBURG, or FEJTWAR, a town of Transylvania, capital of a county, and seat of the bishop of Transylvania, beautifully situated on the Maros. It was a long time the metropolis of Dacia, and the seat of its monarchs, who had a palace here. It was likewise the seat of a Roman legion. The name Alba Julia it owes to Julia Augusta, mother of Marcus Aurelius. Charles V. named it Carlsruhe; 90 miles N.E. of Temesvár. N. lat. 46° 16’. E. long. 24° 10’.

WEISSENBURG See Prussia; 12 miles E. of Lick.—Allo, a town of Bavaria, in the territory of Augsburg; 2 miles S.W. of Fueffen.—Allo, a town of Carinthia; 6 miles S. of Saxenburg.

WEISSENAU, a princely abbey of Germany, in the circle of Swabia. In 1802 it was given to the elector of Bavaria; 2 miles S. of Ravenburg.

WEISSENBERG, a town of the principality of Cumbachs; 5 miles E. of Kirch Lamitz.—Allo, a town of Austria; 12 miles N. of Grein.—Allo, a town of Austria; 9 miles W. of Freyflatt.

WEISSENBURG, a township of Pennsylvania, in the county of Northampton, containing 1046 inhabitants.
WEISSENBORN, a town of Saxony, in the circle of Erzgebirg; 3 miles S.S.E. of Freyberg.

WEISSENBURG, a town of Saxony, in the circle of Erzgebirg; 3 miles S.W. of Zwickau.—Alto, a village of Switzerland, in the canton of Berne, celebrated for its medicinal baths; 18 miles S. of Berne.

WEISSENDORF, a town of Bavaria, in the bishopric of Bamberg; 9 miles S.W. of Forchheim.

WEISSENFELS, a town of the duchy of Carniola; 28 miles W.N.W. of Crainburg.—Alto, a town of Thuringia, on the Saal. It gives title to a branch of the house of Saxony, called Saxe Weissenfels, who ordinarily reside in a citadel above the town, called Augustusberg; 18 miles W.S.W. of Leipzig. N. lat. 51° 14'. E. long. 11° 59'.

WEISSENHORN, a town and citadel of Bavaria, which gives name to a county belonging to the lords of Fuggers; 8 miles S.E. of Ulm.

WEISSENKIRCH, a town of Bavaria, in the principality of Aichstatt; 3 miles S.S.E. of Aichstatt.

WEISSENPACH, a town of Austria; 4 miles N.W. of Bohmisch Waidhoven.

WEISSENSEE, a town of Thuringia, near what formerly constituted an inland lake, which was divided into the Great and Lofs, or into the Upper and Lower, between both which it lay; but the former being drained in the year 1705, and converted into arable and meadow grounds, a small part of it only being then left; and this also has been since dried up; 14 miles N. of Erfurt. N. lat. 51° 10'. E. long. 11° 6'.

WEISSENSTADT, a town of Germany, in the principality of Bayreuth, on the Egara, where it forms a large pond or lake, abounding in fish; 6 miles N.W. of Wamfiedel.

WEISSENTHURN, a town of Sclavonia; 18 miles N.N.W. of Verovtiza.—Alto, a town of the duchy of Slesia; 3 miles E.S.E. of Judenburg.

WEISSESTEIN, a town and castle of Bavaria; 10 miles N.N.E. of Deckendorf.

WEISSIA, in Botany, an Hedwigian genus of mosses, is now, by nearly universal consent, united to Grimmia, for reasons given under that article. There is indeed no difference of habit, nor any certain character, however minute and obscure, between them. This is the more to be regretted, as we have few more meritorious claimants for distinction in cryptogamic botany than Mr. Frederic William Weis, author of the Planta Cryptogamica Flora Goth tingens, an octavo volume, printed at Gottingen, in 1770. No student in that department of the science can dispense with this little book, in which the synonyms of the descriptions are treated with equal practical skill. Fungi, and necessarily Sea-weeds, are excluded from this Flora. We trust some responsible author will restore a Weissia, worthy of bearing the name. The double $\beta$ is a blunder which requires correction.

WEISSLAREUT, in Geography, a town of Germany, in the principality of Culmbach; 4 miles S. of Hof.

WEISSNITZ, or WEISSERTZ, a river of Saxony, which rives in two branches, the Wilde and Rothe, which unite two miles E. of Tharand, and afterwards run into the Elbe, near Dresden.

WEISTHURN, a town of Bohemia, in the circle of Konigingrattz; 6 miles W. of Sclan.

WEISTRAS, a town of Austria; 5 miles E. of Steyr.

WEISTRAS, a town of Sileia, in the principality of Schweinditz, on a river of the same name. Gold is found in the environs; 2 miles S. of Schweinditz.

WEISTRAS, a river of Sileia, which runs into the Oder, near Schweinditz.

WEISWASSER, a town of Bohemia, in the circle of Bolelaw; 6 miles N.W. of Jung Buntzila.—Alto, a village of Sileia, in the principality of Neisse; 4 miles S.W. of Patshauk.

WEISZBACH, a town of Saxony, in the circle of Erzgebirg; 5 miles N.N.W. of Wolkenstein.

WELTENFELDS, a town of the duchy of Carinthia; 2 miles W.S.W. of Grucek.

WELTENHAGEN, a town of Anterior Pomerania; 2 miles S.S.W. of Griefswalde.

WELTENSTEIN, a town of the duchy of Sturia; 8 miles S.E. of Windich Gratz.

WETRA, or WETRACH, a town of Austria; 36 miles N.W. of Krems. N. lat. 48° 41'. E. long. 14° 50'.

WETRASILD, a town of Austria; 2 miles S. of Hardegg.

WETTENEG, a town of Austria, on the Danube; 18 miles above Crems.

WETZ, a town of the duchy of Stiria; 11 miles N.E. of Gratz.

WETZSBERG, a mountain of Stiria; 10 miles N.E. of Gratz.

WEXEN, a river of Austria, which runs into the Danube, 3 miles below Grein.

WELZPACH, a town of Austria; 12 miles W.S.W. of St. Polten.

WELKSDORF, a town of Bohemia, in the circle of Konigingrattz; 7 miles N.W. of Branau.

WELACH. See WELACH.

WELANG, a small island in the East Indian sea. S. lat. 1° 25'. E. long. 130° 30'.

WELAU, a town of Prussia, in the province of Sambard; 28 miles E.S.E. of Konigberg. N. lat. 54° 36'. E. long. 21° 23'.

WELCH MOUNTAINS, mountains of Pennsylvania; 30 miles W. of Philadelphia.

WELCHEIM, a town of Bavaria; 7 miles N.W. of Neuburg.

WELCKERSHAUSEN, a town of Germany, in the county of Henneberg; 3 miles N. of Meinungen.

WELCOME BAY, a bay on the west end of the island of Java. S. lat. 6° 35'. E. long. 105° 30'.

WELD, or WOLD, refusa lutolia of Linneus, a plant used by the dyers to give a yellow colour; and for this reason called, in Latin, lutolea, of luteus, yellow. For the characters, see RESEDA.

When the plants are pulled, they may be set up in small handfuls to dry in the field, and when dry enough, tied up in bundles and housed dry; care being taken to house them loyally, that the air may pass between them to prevent their fermenting. That which is left for seeds should be pulled as soon as the seeds are ripe, and set up to dry, and then beat out for use; for if the plants are left too long, the seeds will scatter. Mortimer and Miller.

Weld is much cultivated in Kent, for the use of the London dyers.

Mr. Hellot observes, in his Art de Teindre, that for dying with weld, the best proportions of alum and tartar for the preparatory liquor are four parts of alum, and one of tartar, to sixteen of the wool; the quantity of the tartar being determined by the greater or less brightness of colour propofed; and that the wool, thus prepared, is to be boiled again with three or four parts of weld to one of wool, but often much less: that for light shades, it is customary to diminish the alum, and omit the tartar; and that, in this cafe,
cafe, the colour is more flowny imbied, and proves less durable.  
With a view to economy, the weaker shades of colour are dyed in the same bath, after the stronger are finished.  
A golden yellow, more or less orange, is given by a weak madder bath, after the welding.  
Silk is dyed of a golden-yellow, generally with weld alone, according to the following process: the stuff is first boiled in soap-water, aluminised and washed, then passed twice through a weld bath, in which, the second time, fome alkali is dissolved, which gives a rich golden hue to the natural yellow of the weld.  
The colour is further deepened by a little annatto.  
The solutions of lime with weld give to filk a bright clear yellow.  
In order to dye cotton yellow, Berthollet directs first to cleanse it with wood ashes and water, to refine, alum, and dry without further rinsing, and then to pass it through a yellow bath, in which the weld is somewhat more than the weight of the cotton.  
When the colour has sufficiently taken, the cotton is thrown into a bath of sulphate of copper and water, and kept there for an hour; after which it is boiled with white soap-water, and, lastly, washed and dried.  
In order to obtain a deeper jonquil-yellow, the aluming is omitted, and, instead of this operation, a little verdigris is added to the weld bath, and the cotton finished with loda.  
Weld is particularly preferred to all other substantces in giving the lively green lemon-yellow.  
It is, however, expensive; and it is also found to degrade and interfere with madder colours more than other yellows.  
We may here add, that the fine delicate yellow, obtained from weld, is much used by the London paper-manufaeturers, and sold in the form of hard lumps, confulting chiefly of chalk saturated with the colouring matter.  
Mellers, Collard and Frier have given the following improved process:—Diffte any quantity of fine whitening in boiling water; add to it one ounce of alum for every pound of whitening, which will occasion a brisk effervescence, and flir these materials well together till the gas is wholly diffengaged.  
On the other hand, boil in a separate vessel some weld with water just sufficient to cover it, for fifteen minutes, filter the yellow decoction, and then mix it with the whitening and alumine in fuch proportions, that the earths may appear to be saturated with the colouring matter.  
Then let the mixture remain a day at ref, and at the bottom will be the precipitated earth firmly united with the colour, and of a fine yellow tinge, which may be conveniently dried on chalk-stones.  
The weld yellow is a water colour, and is never mixed with oil.  
Weld, in Agriculture, is a plant which is not unfrequently cultivated in the field by the farmer as a crop, for the purpose of giving and affording a bright yellow and lemon colour to woollens, filks, cotton, and thread, as well as for its use in the manufacture of check and fulfian, and in fome other intentions.  
It is for the flower-plants that it is principally grown, as being useful in the process of dyeing thefe feveral articles.  
It is often known by the names of woold and dyer’s weld.  
It may be noticed, that in the growth and culture of this plant, the foils moft suitable are those of the fertile mellow kinds, whether of the loamy, sandy, or gravelly forts; but it may be grown with success on fuch as are of a poorer quality; but in the former, the plants will rife to a much greater height, and produce much larger leaves and fiments, than in the latter description of lands.  
It has, however, been flated, that the foil moft suitable to it, in Efle, is the strong fliff loam moderately moif, but not wet.  
A foil rather moif, but moif, feme the moft suitable and proper for it.  
It is necessary, in the preparation of the ground, that there fhou’d be a tolerable degree of finenesses produced in the mould of the foil, which may be effected by repeated ploughings given in the more early spring months, and fuitable harrowings.  
The surface of the land in the seed furrow fhould be left as low as poffible, that the feed may be differefed more evenly over it, and with greater regularity and exactneses.  
In this, as in many or indeed moft other cafes, the feed fhould be collected from the felf plants, and thofe which have remained upon the freams till rendered perfectly ripe; as fuch only vegetates perfectly, and the plants in fuch cafes fhould not be left fand too long, as the feed is liable to fhed.  
It fhould be perfectly fresh when used, as old feed never comes up well, or in fo regular a manner.  
In regard to the proportion of feed which is neceffary, it is commonly from about two quarts to a gallon the acre, according to circumstances, when fown alone: but when mixed with other crops, a little more may be required, which fhould be blended with a little fand, or fome other fuch material, at the time of fowing it on the land, as rendering it capable of being fown more evenly.  
It may be observed in refpect to the time of fowing, that this fort of crop may be put into the ground either in the spring, as about the latter end of April or beginning of May; or in the latter end of summer, as the beginning of August; being moftly fown in conjunction with other crops in the firft period; but when fown alone at the latter fefon, the produce is in general the better and moft full.  
Some of the writers in the Efle Report on Agriculture fpeak of the culture of this fort of crop as fimplly that of transplanting from the feed-beds about Midsummer.  
The feed, in thefe cafes, is fown in the beds in the early fpring, for raising the plants.  
In the county of Norfolk, it is faid, that they fow it in the month of April with barley, in the proportion of from a quarter to half a peck to the acre, in the manner of clover, and frequently with clover at the fame time, to be mown or fed in the following year, after the weld is pulled.  
It is moftly fown broad-caft, whether grown in mixture with other plants or alone; and as the seeds are of a very small fize, it requires an expert feederman to perform the businefs with regularity and exactneses, which is a matter of much importance to the success of the crop, as, where the plants fland too clofely together, much unnecessary trouble and expence must be incurred in the thinning them out by the hoe afterwards; and where they fland too thinly upon the ground, there must be a great lofs from the deficiency of plants.  
That the fowing may be executed with more regularity, it is the custom with fome to blend other fubstances, fuch as the above, with the feed that has nearly the fame weight, as by this means they fuppofe it may be effected with greater exactneses, facility, and readiness.  
It is flated that weld, when grown with other forts of crops, fuch as barley, buck-wheat, beans, peas, clover, or grass-feeds, is ufually put in after them; in fome cafes immediately, but in others not till fome time has elapfed.  
With the firft and second forts, when fown fo late as the beginning of May, it is moftly the practice to fow it directly afterwards, giving the land a flight harrowing with a very light close-tined harrow to cover it in.  
The barley being fown under furrow, the weld-feed with fome is immediately sown over the surface, and lightly harrowed in, and then rolled.  
Where the barley feeding is performed fo early as March,
March, or the beginning of April, the sowing of the weld-feed is best deferred till May, when it may be sown in the chaff breaking or hoeing of the crops in the latter end of June, or beginning of July. In cultivating it with clover and grass-seeds, it is often sown at the same time with them; but a better practice is, perhaps, to delay it till some time afterwards, as both these crops require to be sown at too early a period for this plant to rise safely. But in cases where no other form of crop is grown with weld, which is probably the best method, it is usually sown even the surface of the land, and covered in by harrowing with a light flail harrow, having afterwards recourse to the roller in light forts of land.

Though it is common in cultivating crops of this sort, not to pay any attention to them after being sown; yet as the plants are of slow growth, and liable to be greatly injured in their progress by the rising of weeds, it must be of much benefit not only to keep them perfectly clean, but also to have the mould stirred about their roots. In about a month from the time of sowing, the plants are mostly in a state to be easily distinguished; a hoeing should be then given when the weather is dry, which may be performed in the same manner as for turnips only, using somewhat smaller hoes for the purpose. Some direct that the plants in this operation should be set out to the distance of three or four inches; but it is better to let them have more room, as six, seven, or eight inches; which not only lessens the expense of the buskins, but contributes to the advantage of the crop. In the spring, a second flight hoeing may be practiced about March, in a dry time; and if any weeds rise afterwards, a third may be given in May. Where the land has been well prepared, one hoeing in autumn and another in the spring may be fully sufficient. Hand-weeding, though practiced by some, is in general too expensive in these cases.

It may be observed, that the proper period for pulling this sort of crop is when the bloom has been produced the whole length of the stems, and the plants are just beginning to turn of a light or yellowish colour, as in the beginning or middle of July in the second year. The plants are usually from one to two feet and a half in height. It is thought by some advantageous to pull it rather early, without waiting for the ripening of the seeds, as by this means there will not only be the greatest proportion of dye, but the land will be left at liberty for the reception of a crop of wheat or turnips; but in this case, a small part must be left solely for the purpose of providing feed. In the execution of the work, the plants are drawn up by the roots in small handfuls, and set up to dry, after each handful has been tied up by one of the stalks, in the number of four together in a fort of erect position against each other, as is done in some other kinds of crops.

It is remarked, that sometimes they, however, become sufficiently dry by turning, without being set up. After they have remained till fully dry, which is mostly effected in the course of a week or two, they are bound up into larger bundles, that contain each sixty handfuls, and which are of the weight of fifty-six pounds each; fifty of these bundles constituting a load. These last are tied up by a string made for the purpose, and folded under the title of wool cord, in many places where this kind of crop is much grown and provided for the dyer and calico-printer.

On account of the weld plant being extremely uncertain in its growth, and the whole crop seldom becoming in a state to be pulled at the same time, it is proper to have an experienced labourer to direct the business of pulling, in order that the pullers may not proceed at random, but take the different parts as the plants become ready, or in danger from the bight. In which case, the greatest possible dispatch should be made, as the loss of weight in the produce will daily increase, and the grower be of course greatly injured in the quantity of it.

After the weld is become sufficiently dried, which is known by the crispness of the leaves, and the stems turning of a light colour, and when the plants are ripe, the seeds shelling out; according to some, it should be flaked up lightly in the barn, in order to prevent its taking on too much heat; while others advise, that it should be flaked up closely in the manner of wheat, being left to sweat in the same way as hay, as the more this takes place, the better; the quality of the weld being thereby increased, if there be no moulds or. When the crop has flood till fully ripened, the seed may be taken before it is put into the barn, which may be easily procured by rubbing, or slightly beating each of the little handfuls against each other over a cloth, tub, or any other convenient receptacle, as by threshing, the quantity of the weld would be much reduced in weight. The price of this fort of feed is mostly about ten or twelve shillings the bushel, which may be sold to the feedmen in a ready manner.

It may be observed, that in crops of this kind the produce is in some degree uncertain, depending much upon the nature of the season; but from half a load to a load and a half is the quantity most commonly afforded, which is usually sold to the dyers at from five or six to ten or twelve pounds the load, and sometimes considerably more.

This is a fort of crop which is mostly disposed of to the dyers and calico-printers, as well as other manufacturers. The demand for it, however, is sometimes very little; while at other times it is so great, as to raise the price to a very high degree.

Weld is a crop which is particularly liable to be injured by the bight, which probably has induced the growers of it to raise it with those of other kinds, especially of the grains; because, where the weld crop does not succeed, a portion of sheep feed may be afforded by the others, for winter and spring use. It is noticed, that the bight frequently comes on suddenly, that crops which appeared healthy, and in a vigorous state of growth, during the whole of the winter and spring, promising a large produce, are about the month of May attacked by this vegetable disease, so as to be nearly destroyed. It is known to be present by the plants, especially about the lower parts of the stems of them, turning of a yellow or pale reddish colour, while the upper parts remain green, and seem healthy. When it appears early in the month of May, there is always danger of the crop being destroyed; but when it comes on at a later period, or where the plants from other causes, as the dryness of the season, begin to change colour in the stalks, the only chance is that of having them pulled as expeditiously as the buskins can be performed, and in the readiest manner possible.

It may be remarked, that it would seem better and more convenient to cultivate this crop alone, or without any mixture of other plants; as, in the former way, it must be much injured and confined in its growth, on account of the buskins and shade produced by the plants of other crops that surround it. It is the custom, too, when grown with other crops, especially those of the grains kinds, to very commonly feed them down in the winter and spring feasons with
with sheep, or some other light sort of live-flock, under the
to a sufficient heat for its uniting properly with the former. Silex,
mutual influence that they will not touch the weld plants; but this is
iron, and the girl which are made in this country, have the property
injury to their growth and flowering. In cafes where weld is
is brought up to a welding heat. When, therefore, a skilful
whilst he is bringing the corresponding piece up to a suffi-
but this is by no means the case, as they are found to feed upon them
the oxygen of iron, forms a very fusible compound, which covers the work
on the foreign, and not, as is usually the case, with bricks; because most of the bricks
without any nicety, and must, of course, do very great in-
and without any injurious effect to the latter, for it has got to mature-
the result of their method is probably to pull it out when it has no inju-
flowering. In cafes where weld is
injury to their growth and flowering. In cafes where weld is
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to a sufficient heat for its uniting properly with the former. Silex,
iron, and the girl which are made in this country, have the property

Weld, on account of the great consumption of vegetable food which it causes, without contributing any thing to the
beneficial alteration of the land, can only be introduced with propriety, probably, in situations where manure or substan-
ces of this kind can be easily obtained. However, in cafes where the crops of this kind are cultivated with sufficient

tillage, care, and attention, they may be a good preparation for
wheat or turnips, in some instances.

It may sometimes, too, be grown with advantage in the
neighbourhoods of large dyings, printing, and other such
manufactories, where the consumption, and consequently the demand for it, is very great. If this sort of produce
cannot be disposed of soon after it is pulled and tied up, it
may be preferred perfectly found for several years, by being
stacked either in the barn or on bales in the open air, taking care to prevent the attacks and ravages of rats, or
other vermin.

Weld, or Weald, in a Chorographical Sense. See Weald.

WELDEREN, or Marienburg, in Geography, a town of Germany, in the bishopric of Munster; 3 miles
N. E. of Dülmen.

WELDING, in the Manufactures, denotes the forging of
iron, when intensely heated; or, more generally, the in-
timate union which subsists between the two surfaces of two
pieces of malleable metal, when heated almost to fusion, and
hammered. This union is so strong, that when two bars of
metal are properly welded, the place of junction is as strong
relatively to its thickness as any other part of the bar.

Welding heat is the heat necessary for producing this effect.
Bar-iron cannot be welded to another piece of iron, unless
both be heated to nearly 60° of Wedgwood's pyrometer, which
is equal to 8,877° of Fahrenheit's scale, and is called
the welding heat; but if cast-steel be heated to this point,
it would be fusible, and run from under the hammer; and, therefore, it was for a long time thought to be impossible to
use it in conjunction with iron, in the same manner as the
other kinds of steel are employed. But Mr. Thomas Frank-
land at length discovered, that if the cast-steel be made only
of a white heat, and the iron of a welding heat, the steel
will then be soft enough to unite with the iron, and yet the
former will not become fluid by the operation. It will,
however, be proper to give the necessary temperatures to
the two metals separately, and then to unite them at one
single heat. (Phil. Trans. for 1795, p. 296.) Mr. Parkes
observes, that some nicety is required in the process of
welding iron, so that the outside of the weld does not oxidize
too much and fly off in scales, before the inside is
brought up to a welding heat. When, therefore, a skilful
workman is about to weld two pieces of iron, he carefully
observes the progress of the heat; and if one becomes too
hot, he rolls it in sand to prevent it from the action of the
atmosphere; and when one piece acquires the necessary
temperature before the other, he covers that with sand,

WELDON, Great, in Geography, a small market-
town in the hundred of Corby, and county of Northampton,
England, is situated in Rockingham forest, 4 miles E.S.E.
from the town of Rockingham, and 84 miles N. N. W. from London. A weekly market is held on Wednesdays, but on
a small scale; and here are four annual fairs. The market-
house, over which are the fellion-chambers, supported by
columns, was built by Lord Vicount Hatton. The parish
is famous for its quarrs of rag-iron, which takes a high
polish, and is in great esteem for chimney-pieces, slabs, &c.
In the vicinity of this place were discovered, in the year
1738, some fragments of Roman tesselated pavements, one
of which was ninety-six feet long, and ten broad. Con-
ected with these were the floors of seven rooms; the centre
one, being the largest, was terminated at one end with five
sides of an octagonal projection. Among the ruins were
found several Roman coins of the lower empire. A wall
has been built round the Roman pavement, and a wooden
roof placed over it. Near Great Weldon, and forming
part of the parish, is Little Weldon, a village so called in
reference to the town, though exceeding it in population.

The whole parish, according to the return to parliament in
the year 1811, contained 169 houfe, and 815 inhabitants.
— Beauties of England and Wales, vol. xi. Northamptonshir,

WELDS, a river of America, which runs into the
Connecticut, in the state of Vermont.

WELDIA, a town of Egypt, on the left bank of the
Nile; 5 miles N. of Siut.

WELFORD, a town of England, in Northampton-
town, with 931 inhabitants, including 683 employed in
manufactures; 15 miles N. W. of Northampton.

WELHARTITZ, a town of Bohemia, in the circle of
Prachatitz; 8 miles N. W. of Schutenhofen.

WELIN, a town of Bohemia, in the circle of Chrudim;
12 miles N. E. of Chrudim.

WELITZEN, a town of Prussia, in the province of
Nitten; 5 miles S. E. of Marggabown.

WELKI, a town of Bohemia, in the circle of Kauzim;
7 miles N. E. of Prague.

WELL, a town of Hindooftan, in Vifapour; 12 miles
E. S. E. of Raibaug.—Alto, a town on the north coast of
the island of Sumatra. N. lat. 4° 40'. E. long. 97° 20'.

WELL, a hole dug under ground, below the level or
surface of the water collected in the irriga-

It is usually of a cylindrical figure, and commonly walled
with flone, and lined with mortar.

In sinking wells, it is a consideration of some importance,
that they should be lined with free-flone, and not, as is
usually the case, with bricks; because most of the bricks
which are made in this country, have the property of
hardening the water; but the flone does not produce this
effect.

Vol. XXXVIII.
M. Blondel informs the Royal Academy of Sciences of a device they use, in the Lower Austria, which is accompanied with the mountains of Styria, to fill their wells with water; viz. that they dig in the earth, to the depth of twenty or twenty-five feet, till they come to a clannily earth, which they bore into, continuing the operation till the water breaks forcibly out; which water, in all probability, comes from the neighboring mountains, in subterraneous channels. Caffini observes, that in many places of Modena and Bologna, they make themselves wells by the same artifice. Dr. Derham adds, that the like has been sometimes found in England, particularly in Essex.

In the Philopha"ph"c Transac"f"tions we are informed, by Mr. Norwood, that, in Bermudas, wells of fresh water are dug within twenty yards of the sea, and even lefts, which rise and fall with the tides, as the sea itself does. He adds, that, in digging wells in that island, they dig till they come almost to a level with the surface of the sea; and then they certainly find either fresh water, or salt; if it prove fresh, yet, by digging two or three feet deeper, they always come at salt water. If it be sandy ground, they usually find fresh water; but if hard lime-stone rock, the water is commonly salt, or brackish.

Lay-well, near Torbay, ebbs and flows very often every hour; though somewhat oftener in winter than in summer. Dr. Oliver observes, its flux and reflux sometimes return every minute; though, at other times, not above twenty-five or twenty-eight times in an hour. Philos. Trans. No. 104.

In Scotland they have a well, which Sibbald has mentioned as forre"f"ting"fl"o"rms. It is a deep and large well near Edinburgh, and from the noises heard in it at certain times is called by the people the routting well. They go to this to listen after the tempers of weather, and it is said that storms are particularly foretold by it; and that noises are not only heard in it before storms happen, but that they are always heard determinately and distintly on that side whence the storm will come.

In the Philo"f"phical Tran"f"actions we have an account of a bolting-well, &c. See SPRING.

WELL, in Rural Economy, a deep circular opening, pit, or fort of shaft, funk by digging down through the different strata or beds of earthy and other materials of the soil, so as to form an excavation for the purpose of containing the water of some spring or internal reservoir by which it may be supplied, for domestic or other uses of different kinds.

It is usual to have wells bricked round from the bottom to the top, and frequently to have pumps fixed in them. The width is mostly from three to four feet, which, where the springs are strong, may afford and contain a sufficient quantity of water.

As wells are supplied from springs, and these are formed in the bowels of the earth, by water percolating through the upper strata, and descending downwards until it meets with a stratum of clay or other impervious material that intercepts it in its course, it may naturally be concluded, that an abundant spring for this use need never be expected in any district or place that is covered to a great depth with sand, without any stratum of clay to force it upwards, as is the case in the sandy deserts of Arabia, and the immeasurable plains of Lyb"i"a. Neither are we to expect abundant springs for wells in any soil that consists of an uniform bed of clay from the surface to a great depth; for it must always be in some porous stratum that the water flows in abundance, and it can be made to flow horizontally in that only, when it is supported by a stratum of clay, or other substance that is equally impermeable by water. By this means is explained the rationale of that rule so universally established in digging for wells, that if begun with sand, gravel, or other such matters, it need seldom be hoped to find water until clay is come to; and that if clay be begun with, none can be hoped for in abundance till sand, gravel, or porous rock is met with.

Hence, as the doctrine of wells is so much and so intimately connected with the nature of the strata and the springs afforded by them, it may not be unneccessary to observe, that in cafes where differently formed strata of sand, to a considerable depth, rest upon beds of clay, and have a fine issue at the lowest ends of them, if wells were sunk into the sand-beds higher up no water could be there permanently found until they penetrated quite through the strata of sand, and went to some depth into the beds of clay that lie below them. In such cafes, the water could never rise in the wells much higher than a certain point; because, whenever it rose as high as the porous sand, it would flow along through it until it made its escape below; and if the beds of clay should extend backwards under the ground a great way, and at a great depth below the surface, so as to form an abundant and never-ceasing stream under the beds of sand, it must necessarily follow, that the wells would continue constantly at the same height, exactly as in the cafe of a strong wall at a fountain, into which a pipe of water confluently flows, so as to keep it running over.

If, however, the streams that run below the beds of sand be small, and the draught of water from the wells, at particular times, be uncommonly large, the surface of the water in the wells will of course be made to sink: they may be, indeed, quite drained of water at times, so as to require to be left for a while till they shall fill again. This may be occasionally a very serious inconvenience, and ought to be guarded against by enlarging the reservoir, which may be effected either by widening the diameter of the wells, or by sinking them to a greater depth in the clay, or by both these means. Hence it appears, it is said, that in cafes of this sort, very wide wells ought always to be made. Other cafes, however, will come to be noticed in the course of this article, in which the straitest well that can be made, would supply a quantity of water as abundant as those that are wider. In these cafes, pipes as above will be found very useful.

Nor would the phenomena here described, it is said, be in the least varied if the wells, instead of being dug in the sand immediately below the vegetable mould, should be first sunk through a considerable thickness of some other strata. The depth of the well only would be greater, and all other circumstances the same.

It may be here noticed, that quicksand, when it comes in the way of well-digging, affords impediments which can only be surmounted with great labour and difficulty. The best and most obvious remedy in such cafes when they occur, is probably to endeavour to find the means of opening an outlet by which the water may be suffered to run off or discharge itself. This, where the quicksand is situated above the level of the sea, or some adjoining plain, may in many cafes be effected at very little expence, if due attention be betted upon the position and natural dip of the strata, which may be discovered by various means besides boring. But there are cafes, particularly where the quicksand is produced by a cavity like a bason scooped out of the entire bottom, so as to contain water to a considerable depth, which in some particular situations may be deemed incurable.

It deferves also to be remarked, as a circumstance ne-

ce"s"s"a"r"i"l"y
cellarly accompanying springs of this kind, that the dig-
ging wells in a higher position, will not sensibly diminish 
the quantity of water that flows over the lower surface of 
the clay; for, as the well, as soon as it is filled, must over-
flow, that will not intercept one drop more water than what 
is drawn up out of it. Were it even possible to pump the 
water from the well as fast as it falls into it, so as never to 
allow one drop to run over, the cask would not be much 
altered, because no more water could be thus intercepted than 
that which would have flowed into the mouth of the well in 
its descent; so that every drop that would pass the mouth 
of the well, on either side, would flow forward to the lower 
situation, as if no well had ever been made. Hence we see 
that springs of this sort can never be intercepted by wells, 
or sensibly affected by other wells placed either higher or 
lower than them. Wherever this case exists, water will be 
found nearly in equal abundance, whatever the relative situ-
ation of the well may be in respect to others: nothing but 
an uninterrupted trench, of a size sufficient to intercept all 
the water as it flowed, and to carry it off, could dry up the 
springs or wells below it.

It may also be observed, that if the bed of sand be of 
great extent, if it be at all supported by a bed of clay or 
other impervious matter, water will undoubtedly be there 
found, whatever may be the depth of the bed of sand above 
it, if a well be dug through it; for, as the water that falls 
in showers upon the earth's surface necessarily sinks through 
that pervious stratum, it is soon beyond the reach of the sun, 
so as not to be evaporated, and must sink downwards till it 
meets with an impervious stratum, so that there can be no 
doubt but that under the immeasurable defects of Libya, 
there must be water in abundance to supply any number of 
persons, were wells there sunk to the requisite depth; nor is 
that depth, perhaps, in many cases, nearly so great as has 
been in general apprehended.

There are many other cases of strata and springs, as con-
cerned in the opening and forming of wells, that constitute 
different classes of springs for this use, as those where the 
water is confined and pent up in retentive beds, so as to be 
capable of supplying wells by simply boring down into 
them, or making slight openings in other ways, by which 
the water may flow up. Some instances of these and other 
forts will be noticed and considered below.

In the execution of the work of digging wells, there is 
no great difficulty, the perfor in employed in the buffins 
chiefly working down by means of a small short-handled 
spade and a small implement of the pick-axe kind; the 
earthly materials being drawn up in buckets by the hand or 
windlass fixed over the opening for the purpose. Where 
perforors connect with this sort of buffins are employed, 
they usually manage the whole of the work, bricking round 
the sides with great facility and readiness; but in other 
cases, it will be necessary to have a bricklayer to execute 
this part of the buffins. As the expense and trouble of 
digging and getting up the materials in these cases are con-
siderable, other means have been had recourse to, in order to 
lessen or prevent them. The most ingenious of these is that 
proposed by a French philosopher, who has advised that the 
ground should be perforated to a sufficient depth by means 
of an auger, or borer; a cylindrical wooden pipe being then 
placed in the hole and driven downward with a mallet, and 
the boring continued, that the pipe may be forced down to a 
greater depth, so as to reach the water or spring. In propor-
tion as the borer becomes filled with earth, it should be 
drawn up and cleared, when by adding fresh portions of 
pipe, the boring may be carried to much extent under 
ground, so that water may in most cases be thus reached and 

obtained. It is stated that wells made in this manner are 
superior to those constructed in the common method, not 
only in point of cheapness, but also by affording a more cer-
tain and abundant supply of water, while no accident can 
possibly happen to the workmen employed. In case the 
water near the surface should not be of a good quality, the 
perforation may be continued to a still greater depth, till a 
purer fluid can be procured; and where wells have become 
injured or tainted from any circumstance or accident, when 
previously emptied, and the bottom perforated in a similar 
manner, so as to reach the lower sheet of water, it will rise 
in the cylindrical tube in a pure flat into the body of the 
pump fixed for the purpose of bringing it up.

This is certainly an ingenious, ready, and safe method of 
forming wells; but it requires a large expensive boring 
auger, and which, if carried to any great depth, would 
stand in need of an apparatus for being wrought by means 
of horse-power. Besides, other parts would be necessary, 
such as punches, chisels, and other such mouth-pieces, for 
being fixed on occasionally, in order to work through hard 
strata of many different kinds; and, in some instances, it 
would be liable to be wholly impeded by the nature of the 
substances through which it had to get in its passage to the 
water or spring. In some cases, it may, however, answer in 
a ready and perfect manner, and be of great use and conve-
nience. There would be much difficulty, too, in driving 
down the wooden pipes in many cases, especially if to any 
considerable depth, and great nicety be required in making 
them so as pretty exactly to fit the aperture formed by the 
boring auger. And, besides, from their smallness, except 
they were made from cast-iron, or some other proper metal, 
they would not by any means be durable, but speedily be-
come leaky and out of order. The best mode would 
therefore probably be that of having metallic-pipes cast 
for the purpose, and so formed as to fit exactly upon each 
other, to any depth that might be necessary in sinking 
wells.

In some cases and kinds of strata, wells formed in this 
manner could not, however, answer perfectly, as they re-
much width or space at the bottom parts, and some-
times to be dug considerably into the impervious bed or 
matter, as seen above.

It may be necessary and useful to flow the nature of the 
different beds or layers of materials which are dug or sunk 
in forming the openings for wells in different cases, 
as well as the manner and heights to which the water or 
springs rise in them under various circumstances. Some 
cases of wells are stated in the Corrected Report on Agri-
culture, for the district about the metropolis, that explain 
these points in a pretty clear manner.

It is noted, that in the year 1791, the present vicar of 
Northall, then Mr. archdeacon Eaton, agreed with Mr. 
White, of Putney, to sink a well in the court adjoining to 
the vicarage. The workmen first dug through a bed of 
fold blue clay 60 feet in depth, under which was a stratum 
of rough porous stone about a foot thick. To this suc-
ceeded a second stratum of clay, differing a little from the 
former in colour, 29 feet in depth; then a stratum of fine, 
grey sand, intermixed with extraneous fossils, oyster-
hells, bivalves, &c. This stratum continued for twenty-
three feet, and was succeeded by another of clay, of a red 
or ferruginous colour, firm in its consistence, but of which 
occurred before, and intermixed now and then with 
gravel and stones of a considerable size. After digging 
down this stratum for fifty-one feet, at the depth of one 
hundred and sixty-four feet from the surface, water was 
found, which, on the removal of the stone which lay imme-

O o 2
Within the former Norland-house, the marl, sand and clay of the bed of the river being now only one hundred and sixty feet.

**Depths of strata passed through:**

<table>
<thead>
<tr>
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<th>Feet</th>
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<tbody>
<tr>
<td>1 Clay</td>
<td>60</td>
</tr>
<tr>
<td>2 Stone</td>
<td>1</td>
</tr>
<tr>
<td>3 Clay</td>
<td>29</td>
</tr>
<tr>
<td>4 Sand</td>
<td>23</td>
</tr>
<tr>
<td>5 Clay</td>
<td>51</td>
</tr>
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<td>164</td>
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At Mr. Munday’s brewery at Chelsea, a well was dug about the year 1793, to the depth of three hundred and ninety-four feet, within twenty or thirty feet of the edge of the river, mostly through a blue clay or marl. At the depth of near fifty feet, a quantity of loose coal, twelve inches in thickness, was discovered; and a little sand and gravel were found about the same depth. The well-digger usually bored about ten, fifteen, or twenty feet at a time lower than his work, as he went on; and on the last boring, when the rod was about fifteen feet below the bottom of the well, the man felt, as the first signal of water, a rolling motion, something like the gentle motion of a coach passing over pavement. Upon his continuing to bore, the water presently pushed its way by the side of the auger with great force, scarcely allowing him time to withdraw the borer, put that and his other tools into the bucket, and be drawn up to the top of the well. The water soon rose to the height of two hundred feet.

In 1794, a well was sunk at Norland-house, for Mr. Vuliamy, a little on the road towards the town of Uxbridge, to the depth of two hundred and thirty-five feet, and then a hole of five inches and a quarter was bored down, and a copper pipe of the same diameter as the borer, was driven down to the additional depth of twenty-four feet into a stratum of sand filled with water; when a mixture of sand and water instantly rushed upwards through the aperture of the pipe in such abundance, as to rise one hundred and twenty-four feet, that is, one hundred feet in the well part, and twenty-four in the pipe, in the course of eleven minutes; and one hundred and nineteen feet more in one hour and nine minutes; or on the whole it rose two hundred and forty-three feet in one hour and twenty minutes. A found line was then let down, which discovered that sand had roe in such quantity as to fill the well to the height of ninety-five feet. This was under the necessity of being repeatedly dug out, by which the sand was ultimately reduced so considerably as to permit the water to rise through it more and more freely, until it flowed over the top of the well at the rate of forty-five gallons in the minute. There is full, however, a great body of sand in the well, through which the water filters by ascent, which is excellently calculated for freeing it from every sort of impurity. If a greater supply of water at this well were necessary for the valuable purpose of turning machinery of any sort, or for any other such use, it might certainly, it is said, be obtained after the rate of several hundred gallons in the minute, by continuing to clear out the sand until the obstruction it affords should become of little consequence; but, in this case, the quality of its water is of more importance than the quantity. The water, in this instance, is now had in a very high state of purity, as the originally excellent water, rendered foul by flowing in a stratum or body of clear sand, is further purified and improved by filtering by ascent through many feet in thicknesses of the same material.

Other circumstances have occurred in digging and forming wells in different situations. It is stated in the Rural Essays, that in sinking a well at Sheerns, near the mouth of the river Thames, sometime since, some extraordinary phenomena or appearances occurred, many of which were deemed, by different persons, rather of a wonderful kind. They were these: that fort is placed upon a neck of land, very little elevated above the surface of the sea. In digging the well, they passed first through a bed that consisted wholly of sand to the depth of thirty feet, the whole of the water found in which was of a salt taste, when at that depth they discovered a spring of salt-water, which, not being irresistibly abundant, they found themselves enabled to wall out; which being accomplished, they then sunk further, through a bed of clay for some fathoms more. They here found another spring of salt-water, as before; which having walled out in a similar manner, they continued to dig through the same bed of clay, for three hundred feet more; at the bottom of which they found a bed of gravel, from which issued a copious stream of fresh water, which soon filled the well within five feet of the top; at which height nearly it has ever since remained.

Extraordinary as these circumstances may appear, they are perfectly explicable on the principles and appearances which take place in boring and tapping springs. The fresh water, in this case, being confined and pent up at a very great depth in the earth, by impervious beds of materials, when the gravel or porous stratum that contained the water was sunk down into it, was forced up and rose, of course, to the height of the internal source or reservoir from which the water originally came in the distant high ground. If the spring in this instance should afford more water than is taken from the well, it will continue always about the same height; so that the water can only sink in the top of the well, when more is drawn from it than the spring can supply in a given time. See Tapping Springs.

The springs of salt-water in this case are capable of being explained on the supposition of fissures or openings having been formed by the working of some sort of animal, or other unknown cause, so as to have penetrated the bed of clay, from the edge next the sea to some distance, as far inward, at least, as the opening of the well; through which, of necessity, salt-water would flow into the well as soon as it was opened. See Philosophical Transactions, vol. 74.

Another instance of a somewhat similar kind, though less complicated, as being divested of the circumference of the salt-water, is mentioned to have taken place at Derby, under the direction of a late eminent physician and philosopher. A well was sunk in that place, which lies in a bottom, surrounded by many different hills; in which, after digging through a bed of clay for some considerable depth, an abundant spring of fresh water was found, which, as in most cases of this nature, rushed up with great impetuosity, and soon filled the well to the top, where it flowed over in a pretty full stream. This was instantly seen, and conceiving that it probably descended through some narrow subterraneous passage, from a height greater than that of the houses of the town, readily imagined that if the sides of the well could be raised to a sufficient height, making them at
the same time strong enough to bear the pressure of the water within, it might be conveyed by this means to the highest floors of the houses; which was actually effected to the great convenience and advantage of the family.

The same circumstances might be taken advantage of in many other situations and cafes, with equal benefit and convenience in this way, and still more in many others, especially in theturning of machinery.

Even the situation of the metropolis itself is said to afford a strong example in elucidation of the same general principle. It is well known that this is every where built upon a solid bed of clay, that extends to a great depth, and which lies above a large bank of water there confined and pent in, so that in no way be let off or discharged; in consequence of which, it is with certainty known, that water may be found by finking a well in any place; and that the well-diggers are become so expert, that they can with little difficulty tell, until within a few feet of the depth to which the well must be sunk before water be found. They know, too, that when the water is found, it always rises in the well until it reaches a certain height, where it remains stationary ever after, never rising or falling scarcely more than an inch from its level under any diversity of season; and if the workmen be permitted to take their levels from a known point, they can tell, before they begin to dig, the precise length of pump that will be required to raise the water to the surface.

Thus, if a well be sunk in one of the lowest situations in the city, as about Fleet-market, and it should be found that it there requires to be dug forty feet before water is met with, and that the well makes a fort of drawing or tapping, the water will rise in the well to the height of a certain level, where it will, of necessity, become stationary, which is at the height of about ten feet from the surface of the ground. In St. Paul's church-yard, which by a careful level has been found to rise fifty feet above the former situation; the well in this place will require to be sunk about ninety feet before it reaches the water, and that the water will rise to the certain level, and no higher; so that there the water will require to be lifted fifty feet to reach the surface of the ground. If in a lower part of the town, as about Aldgate and Fenchurch-street, the water there is found at fifty feet, and will rise to within thirty feet of the top. If about Thames-street, and its continuations near the river, the depth to which the wells must be dug, and the distance from the surface of the ground to the water will be rather various: in some cafes, the water would rise within three or four feet of the surface, and in low places, run over the top. The depth of digging will be mostly much less than in the last cafe before the water is reached.

A cafe, which is strikingly illustrative of wells where they flow over the tops, is recorded by the above writer, as having also lately occurred in the vicinity of the metropolis. A gentleman bought a house and farm a little beyond Kennington gravel-pits, on the right-hand side of the road, nearly opposite to Holland-house. The premises were entirely defitute of water, which appeared to the occupier to be a great inconvenience, that he determined to try if he could find any there by finking a well, and resolved, rather than not succeed, to go to a very great depth. He began digging, and went down very far without discovering any symptoms of water; but not discouraged by this circumstance, he still proceeded. At length, when he had gone very deep, he found water, and was infinitely more fortunate than he expected; for he feared that after he had found water, it would be necessary to raise it by artificial means from so great a depth, as much greatly enhance the price of it. The water, however, rose in the well very quickly till it reached the top, and there it ran over in a very copious stream, overflowing the field around it, till it found out a level for itself, forming a living rill, that continues to flow at all times of the year. The owner of the ground, after having made of it a fine piece of water for his pleasure, and supplied all his building with it abundantly, made that part of it issue through a pipe into a stone balon by the road side, for the accommodation of passengers of every fort; where it still continues to flow, running from thence along the ditch to the bottom of the eminence on which it stands; the surplus water from the pond being conveyed off by another channel.

These cafes of wells are still further illustrated and explained by the nature of what happens in finking deep pits and shafts in many places for different purposes, and from the large burials of internal waters which take place in many instances and situations. See QUARRIES, &c. Draining of, and SPRING-Draining.

On the whole, the facts and statements which have been given above, may sufficiently explain and elucidate the manner in which water is supplied and obtained in the digging and forming of wells, as well as the nature and distribution of the strata by which it is conducted, contained, and forced up into them. However, in most cafes, before the finking of wells is undertaken or begun upon, the nature of the different circumstances of the particular cafes should be well and fully inquired into and considered, and the probability of success coolly and maturely weighed from a due examination of the different springs and wells in the immediate neighbourhood; as where this is not the case, much labour, trouble, and money, may often be expended to little or no purpose, and great disappointment be sustained.

WELL-Digging, the art of finking wells, and lining them with stone or brick, that they may preserve their figure; as this operation is necessary for wells in all soils except rock. There are two methods of building the stone or brick within the well, which is called the lining. In one of these a circular ring is formed, of the same diameter as the intended well; and the timber of which it is composed is of the size of the brick-courses, with which the well is to be lined. The lower edge of this circle is made sharp, and shod with iron, so that it has a tendency to cut into the ground; this circular kirb is placed flat upon the ground, and the bricks are built upon it to a considerable height, like a circular wall. The well-digger gets within this circle, and digs away the earth at the bottom; the weight of the wall then forces the kirb, and the brick-work with which it is loaded, to descend in the earth, and as fast as the earth is removed it sinks deeper, and the circular brick-wall is increased or raised at top as fast as it sinks down; but when it gets very deep, it will sink no longer, particularly if it paffes through loft strata: in this cafe, a second kirb of a smaller size is sometimes began within the first.

When a kirb would not sink from the softness of the strata, or when it is required to drop out water, the bricks or stones must be laid one by one at the bottom of the work, taking care that the work is not left unsupported in such a manner as to let the bricks fall as they are laid: this is called under-pruning.

Well-diggers experience sometimes great difficulty from a noxious air which fills the well, and suffocates them if they breathe it.

The usual mode of clearing wells of noxious air, is by means of a large pair of bellows and a long leathern pipe, which is hung down into the well to the bottom, and fresh air is forced down to the bottom by working the bellows. This
This is intended to displace the damp air or gas, but is not very efficacious, because the damp air is of a greater specific gravity than pure air; so that ten gallons of fresh air is perhaps blown into the well, before two gallons of noxious air is displaced; and this probably happens because the atmospheric air is specifically lighter than the noxious air, and ascends through the latter to the top of the well, displacing but a small quantity of it. Such bellows, &c. are seldom to be procured on the spot when wanted, and are too weighty and cumbersome to carry about. If water is thrown down in a flower, it will sometimes clear the air; but this is laborious, in a deep well, to draw it up again.

The following apparatus may be used with great success in such cases; and as with sixty feet of pipe its weight amounts only to thirty pounds, it may easily be carried to any distance. Tubes of every kind being perpendicularly situated, and having their internal air rarefied, cause a current or stream of air to ascend through them. Suppose six lengths of metal pipe, each eight feet long, and two inches diameter, all made of tin plate, except the upper one, which is of copper, the better to bear the heat; let a cylindrical vessel be also made of copper, holding about two gallons, fixed fast to the upper pipe, and having through the sides of it a number of holes to admit air for the support of the fire, which is kindled within it. The vessel must be so fixed as to have at least five feet of pipe above its top.

The method of placing it in the well is, first, to lower down the bottom length, into the upper end of which, the lower end of the second length is joined, passing a wire through both to prevent their drawing apart again in holes made for that purpose; then fill the joint round with oil-putty, so as to render it air-tight. The upper end of each length of tube is wired, to prevent bending; which wiring also forms a receptacle for the putty. Then proceed in the same manner, with the remainder of the pipes, until the bottom one nearly reaches the surface of the water, but not quite. The fire-pan is to be supported on two timbers, placed for that purpose across the top of the wall, and a conical cover may be fitted over it to prevent the heat from passing away too rapidly, and to confine it to the sides of the pipe. The apparatus being thus fixed, it soon becomes filled with air of the same quality as that in the well; and as their power of gravity is the same, both the external and internal air become stationary, from which there can be no good effect. To put the experiment into execution, fill the fire-pan with lighted charcoal or wood, &c. the copper-pipe which is surrounded by the fire, being by this means heated, a rarefaction of the internal air takes place, which air by this means is lightened, and the external dense air, continuing to press with the same weight as before into the bottom of the tube, the equilibrium is destroyed, and a succession of noxious air passes up through the pipe, as through the funnel of a chimney, till the whole quantity is carried off; after which the pure air, which has in the meantime introduced itself into the well, begins to pass off by the same passage so long as the fire is continued, though the stream of air passing out of the top of the vertical pipe is small, yet the effect is great, because that stream confines entirely of noxious air that is required to be removed. The effect will be greater when the fire-pan is placed lower on the pipe, as by that means more external air becomes rarefied; but if the fire-pan is placed too low down in the well, the charcoal fire produces carbonic acid gas in great quantities, and renders the air in the well unfit for respiration.

WELL, in Agriculture, a term sometimes applied to a fort of pipe-chimney or vent-hole left in a stack, rick, or mow of hay, or other similar materials, in order to prevent its being overheated. Such vent-holes should be avoided as much as possible in all cases, as injuring and destroying much hay about them, and being hurtful in other ways. See Stacking Hay.

WELLS, Ebbing and Flowing, in Rural Economy, such as have their waters rising and falling in an almost momentary alternate manner. See Spring, and WELL.

WELLS, Farm or Field, in Agriculture, such as are dug in these situations for the use of live-flock.

Wells of this sort are of much use and convenience, as they prevent the trouble and disadvantage of driving cattle to distances for the purpose of getting water. See Pond.

WELL, in the Military Art, denotes a depth which the miner sinks into the ground, from which he runs out branches or galleries, either to prepare a mine, or find out, and disappoint, the enemy's mine.

WELL, in a Ship, an apartment formed in the middle of a ship's hold to incline the pumps, from the bottom to the lower deck. It is used as a barrier to preserve those machines from being damaged by the friction or compulsion of the materials contained in the hold, and particularly to prevent the entrance of ballast, &c. by which the tubes would presently be choked, and the pumps rendered incapable of service. By means of this enclosure, the artificers may likewise more readily descend into the hold, in order to examine the state of the pumps, and repair them as occasion requires. Falconer.

WELL of a Filling Vessel, an apartment in the middle of the hold, which is entirely detached from the rest, being lined with lead on every side, and having its bottom pierced with a sufficient number of small holes, passing also through the ship's floor, so that the salt-water running into the well is always kept as fresh as that in the sea, and yet prevented from communicating itself to the other parts of the hold. Falconer.

WELL also implies in the same range, or even with a surface.

WELL-Drain, in Agriculture, that sort of vent or discharge for the wetness of land, which is constructed in some what the well or pit manner. See WELL-Draining, and SPRING-Draining.

WELL-Draining, that means of clearing lands from wetness which, in certain flat situations, is accomplished by making large deep pits or wells, and the constant or occasional use of suitable machinery. In the execution of the business of forming a draining well in loose ground, a sound wooden frame is necessary to be funk, as the work of digging the well or pit proceeds; the sides of which being made, so as in the end to be sufficiently open to pass through, to admit the water to enter freely within it, and close enough to prevent greater matters from interrupting the machinery; especially when of the mill kind. The size of the frame for this purpose must, consequently, be adapted and suited to the nature of the engine which is employed. The lavas of a mill, it has been observed, would require a length of frame, which must necessarily be proportionally strong; but, that for a pump, a frame of incon siderable expense would be sufficient; whether of wood or uncemented brick-work.

In this sort of draining, which is applicable in many cases of cold wet flat lands lying in the valley-tracts in most parts of the country, the wetness is drawn off by these sorts of powerful machinery, working in the spring time, after wet seasons, or at other periods when necessary or wanted. See SPRING-Draining.

WELL-Grown, in Ship-Building, implies, that the grain of the wood follows the shape required, as in knee-timbers, &c.
WELL-Hole, in Building, is the hole left in a floor, for the fillers to come up through. See Stairs.

WELL-Room, of a Boat, denotes the place in the bottom where the water lies, between the ceiling and the platform of the florn-sheets, from whence it is thrown out into the sea with a scoop. Falconer.

WELL-Water. See Water.

WELLAND, in Geography, a river of England, which passes by Stamford, Market Deeping, Spalding, &c. and empties itself into the German sea, in what is called “The Wash,” between the counties of Lincoln and Norfolk. Also, a river of Canada, which runs into the Niagara, between lake Erie and lake Ontario.

WELLE CORONDE, Sandy Cinnamon, a name given by the Ceylonese to a species of cinnamon, which feels hard and gritty between the teeth, as if it were full of particles of sand, though in reality there is no sand among it.

The bark of this tree comes off very easily: but it is not so fit to roll up into quills as the right cinnamon, for it is more rigid and fluffbom, and apt to burst open. It is of a sharp but bitterish taste. The roots of all the cinnamon trees yield more or less camphor, but this is as small a quantity as of any of them. Phil. Tranf. No. 409.

WELLES, in Geography. See WELLS.

WELLESCHIN, a town of Bohemia, in the circle of Bechin; 10 miles S. of Budweis.

WELLESMITZA, a town of Servia, on the Danube; 10 miles S.E. of Orfova.

WELLFLEET, a township of Massachusetts, in the county of Barnstable, containing 1402 inhabitants, with a large harbour near Cape Cod. The inhabitants own 25 vessels, from 30 to 100 tons, employed in the whale, cod, mackerel, and oyster fishing; 60 miles by water S.E. of Boston.

WELLFLEET Bay, a bay of the slate of Maine, in the E. side of Cape Cod Bay.

WELLIA TAGERA, H. M. in Botany, a curious and curious plant of Malabar, with a pungent-petalous flower, and long flat pods, with transverse partitions between the contained seeds. It grows to the ordinary height of a man, with a stem as big as a man’s arm, and is transplanted into gardens only on account of its beauty. It is an evergreen.

All the parts of this plant, the root excepted, are exhibited, with an addition of cummin, white fugar, and milk, against a virulent gonorrhoea. The leaves boiled in cow’s milk, or used in baths, expel the gout. The bark, triturated with fugar and water, is proper for the diabetes. The bark of the root, and green saffron mixed with milk, give relief under the nodule gout, called by the Malabarians fo-nida badda. Rail Hill Plant.

WELLIBALDSBURG, St., in Geography, a town and citadel of Bavaria, in the bishopric of Achfhat, near Achbfhat.

WELLIN, a town of Bohemia, in the circle of Königratz; 16 miles S.W. of Biczow.

WELLINGBOROUGH, a market-town in the hundred of Hamford, and county of Northampton, England, is principally situated on a red sandstone rock, of which material the houses are generally built. The town is disposed along the slope of a hill, nearly a mile to the north of the river Nen, 11 miles N.E. by E. from the county-town, and 68 miles N.N.W. from London. It appears to have been of some note in the Saxon times, when a great part of it was destroyed by the Danes. After the Norman Conquest, it occurs among the numerous poffessions annexed to the abbey of Croigland, in Lincolnshire; and at the suit of the monks of that house, was constituted a market-town, by a charter from king John. In July 1738, it is stated, that about eight hundred dwelling-houses, besides out-houses, &c. were consumed by fire. A new town has been raised, and now affumes a much more respectable appearance than before the conflagration. The church is a spacious edifice, having at its west end a tower, surmounted by a spire; the roofs of the aisles, chancel, and chantry chapel, are decorated with various carved work; and on each side of the chancel are three flails similar to those in cathedral choirs: the eastern window is richly ornamented with tracery, and sculpture in stone. This church had a gift to the honour of the Blessed Virgin; the revenues of which fraternity were, in the second year of Edward VI., appropriated to the erection and endowment of a free grammar-school. Here are also a large charity-school, and two meeting-houses for the public worship of Independent Dissenters. A weekly market is held on Wednesdays; and three fairs annually. The chief source of traffic is corn, the market for which is greatly improved by the decay of that of Higham-Ferrars, at four miles distance. Here is also a considerable manufacture of lace; as also of tammies, harrateens, and other worsted fluffs. In the population return of the year 1811, the inhabitants of this parish are enumerated as 3999, occupying 749 houses. About half a mile to the north of the town, in an open field, is a chalybeate spring, called Sedliwell, formerly much celebrated for its medicinal virtues: in the year 1626, king Charles and his queen refreshed here a whole season, for the benefit of drinking the water, pure from the source.—Beauties of England and Wales, vol. xi. Northamptonshire; by the Rev. J. Evans, and J. Britton, F.S.A. Bridges’s History of Northamptonshire, 2 vols. fol. 1791.

WELLINGTON, a large market-town in the hundred of Kingbury Well, and county of Somerset, England, is situated on the borders of Devonshire, at the distance of 20 miles W.S.W. from Somerton, and 149 miles in the same bearing from London. The earliest historical account of it commences with the reign of Alfred, who bestowed the manor on Asser, who had been tutor to several of his children, and was afterwards advanced to the see of Sherborne, and died poffessed of that dignity, in the year 883. After his death, the king granted the manor to the first bishop of Wells, for the support of the episcopal honours of himself and his successors. It continued annexed to that see, till the reign of Edward VI., when it became the property of the duke of Somerset by purchase from bishop Barlow. The town consists of four streets, the principal of which, called the High-street, is very wide and spacious; the houses are in general well built and commodious. It is a place of considerable trade: the chief articles manufactured here are, ferges, druggets, and pottery. A weekly market, on Thursdays, is well supplied with all kinds of provisions; and two fairs are annually held. According to the population return of the year 1811, the parish contained 775 houses, and 3874 inhabitants, of whom 565 families were flated to be employed in trade and manufacture. The church is a spacious structure, consisting of a nave, chancel, two aisles, and two small chapels. At the west end is a fine embattled tower, a hundred feet in height, decorated with twelve pinnacles of excellent workmanship. In the fourth chapel is a magnificent tomb in honour of sir John Popham, lord chief justice of England, in the reign of queen Elizabeth. On the table of this monument are the effigies of sir John and his lady, under an arched canopy, richly ornamented with the family arms, rosettes, paintings, and obelisks. The whole is supported by eight columns of black marble, five feet high, with Corinthian capitals, green and gilt. Sir John was a munificent patron to Wellington; among
among other benefactions, he erected an hospital for six men and six women, being old and infirm; two children were also to be educated here. This edifice is still standing; for John endowed it with an estate in land, which is vested in governors, and properly applied.—Beauties of England and Wales, vol. xiii. Somerteshire. Collinson's History of Somerteshire, vol. iv. 1791.

WELLINGTON, a small market-town in the Wellington division of the hundred of Bradford, and county of Salop, England, is situated near the Wrekin-hill, at the distance of 12 miles E. by S. from Shrewsbury, and 151 miles N.W. from London. It is neatly built, and contains many good houses. The market, which is held on Thursdays, is well supplied, and much frequented; and there are three annual fairs. The church, which has been lately rebuilt, is supported on cast-iron pillars, and the window-frames are of the same material, which gives a lightness to the edifice; one of the frames is fifteen feet in height. Near the church is a very respectable charity-school. In this town and its vicinity, at the commencement of the civil war, king Charles, then on his march to Shrewsbury, mutter'd his forces, and after issuing orders for the observance of strict discipline, made a solemn pronouncement that he would defend the established religion, govern by law, and prefer the liberty of the subject; and that if he conquered he would uphold the privileges of parliament. The parish of Wellington includes, besides the town, six townships. The return of the year 1811 rates the population to be 8213; the number of houses 1724. The chief employment of the inhabitants is in the coal-works; there are also some mines of iron-ore. About two miles southward from the town is the Wrekin, a stupendous mountain 1100 feet in height. Through the adjacent country runs the Roman road called the Watlingstreet.

Beneath the Wrekin, and adjoining the road leading to Shrewsbury, is Orleton, the seat of William Chudde, esq. of an ancient family in this county. The mansion at present has a modern appearance, but is of very great antiquity, and till of late was enclosed with walls and a gate-house, and was surrounded by a moat.—Beauties of England and Wales, vol. xiii. Salop; by J. Nightingale, and R. Rylance, 1811.

WELINKOVEN, a town in Germany, in the county of Mark; 6 miles W. of Schwieri.

WELLOE, (The,) a rock in the English Channel, near the coast of Cornwall; 9 miles S.E. of Penzance. N. lat. 5°. W. long. 5°. 14'.

WELLS, William Charles, F.R.S., I. and E., licentiate of the Royal College of Physicians, London, and one of the physicians to St. Thomas's Hospital, in Biography, was the son of parents who left Scotland and settled in Carolina, in 1753, and born in Charlestown, South Carolina, in May 1757. Few lives have been more diversified by incident and more sedulously devoted to literary and scientific pursuits, and therefore more entitled to notice in our biographical sketches than the subject of this article. Before he had attained the age of seven years, he was sent to a considerable grammar-school at Dumfries, where he remained nearly two years and a half; and in the autumn of the year 1770 he removed to Edinburgh, and attended several of the lower classes of the university. At this early age he had the good fortune to become acquainted with Mr. David Hume and Sir William Miller, now known by the title of lord Glenlee, whose friendship he afterwards cultivated and valued, and whose kind offices he gratefully acknowledged. In 1771 he returned to Charlestown, and was apprenticed, in the medical profession, to Dr. Alexander Garden, whose name is well known among naturalists; and during three years of the time he was with this gentleman, he pursued his studies with such diligence, that he acquired perhaps more knowledge than in any three subsequent years of his life. Soon after the commencement of the American war, in 1775, he came to London. The occasion of his removal was his refusal, from conscientious motives, to sign a paper denominated "The Association," which was drawn up in order to unite the people in a resistance to the claims of the British government. At the commencement of the winter of that year he went to Edinburgh, and entered upon his medical studies, with the view of taking a degree. To his former two friends, with whom he had kept up a regular correspondence, he had now the happiness of adding a third, no less intimate and constant than the others, the present Dr. Robertson Barclay. Having pursued his studies for three winters, and passed his preparatory trials in the summer of 1778, he left Edinburgh without graduating, and returned to London, where he attended a course of Dr. William Hunter's lectures, and became a surgeon's pupil at Bartholomew's hospital. In 1779 he went to Holland as surgeon to a Scotch regiment, in the service of the United Provinces; but receiving offensive treatment from the commanding officer, he resigned his commission, and challenged theaggrieve, under an unfavourable military subordination, for which an attempt was made to punish him; but without receiving the satisfaction which he demanded, he went to Leyden in the beginning of the year 1780, and there prepared an inaugural thesis on the subject of "Cold," which was published at Edinburgh in the close of that year, on occasion of his taking the degree of doctor in medicine. At this time he commenced his acquaintance with Dr. Lifter, a gentleman no less distinguished for his integrity and liberality than for his skill in his profession; and it redounds in no small degree to the honour of Dr. Wells, that their friendship continued without interruption till his death. Nor was it less honourable to both these gentlemen, that they were introduced to an acquaintance with each other by their common friend Dr. James Currie, the author of "Medical Reports," and the biographer of Burns; whose premature death was lamented by all who knew him, and were duly apprized of the eminent rank which he occupied in the medical profession. In the beginning of the year 1782 Dr. Wells visited Carolina, then in the possession of the king's troops, for the purpose of arranging the affairs of his family; and while he was there, he fattened a variety of offices, seemingly very incompatible with each other, and which no peron deliniate of his veritable talents and peculiar activity could have satisfactorily performed. He was an officer in a corps of volunteers, a printer, a bookseller, and a merchant, a trustee for the management of the affairs of some of his father's friends in England, and on one occasion a judge-advocate. In December 1782, when the king's troops were obliged to evacuate Charlestown, he removed to St. Augustine, in East Florida, and there edited the first weekly newspaper that had been published in that country, having brought with him a printing-prefs, which had been taken to pieces for the convenience of carriage, and which he contrived, with the assistance only of a negro-carpenter, to refit for use. During his residence in Florida, he became captain of a corps of volunteers, and manager of a company of officers, who had agreed to act for the benefit of the poor of the loyal refugees from Carolina and Georgia, and occasionally an actor himself. In 1784 he removed from St. Augustine to London, and becoming acquainted with Dr. Baille, commenced an intimate, steady, and affectionate friendship, the benefits of which he experienced till his death. Having spent three months at Paris in the year 1785, he returned to London in
the autumn of that year, and settled as a physician in this city. His father had resided in London from the commencement of the American war, and had amassed a fortune of 20,000l.; but by misfortunes in trade his circumstances were now embarrassed, so that Dr. Wells, at the outset of his profession, was obliged to raise money by loans, amounting to 600l. For the first few years after settling in London he fearfully took a fee, and after having been engaged for ten years in the exercise of his profession, his receipts from every source did not amount to 250l. per annum. However, in the next five years he was able to pay part of his debt, and before his death he had the satisfaction of having paid the whole of it, both principal and interest; and it should be mentioned to his honour, that when his income was very limited, he allowed an annuity of 20l. to a poor relation.

In 1788 he was admitted a licentiate of the Royal College of Physicians in London; and he took part with those who afforded their eligibility and right of admission to the clafs of fellows. After the decision of this claim in the court of king's bench, he applied in 1797 for examination, so that if he were found to be fit, he might be returned a fellow. But this application was unavailing; and yet about four years before his death the president of the college sent him a message, expressing a wish to know if he had any desire to become a fellow; to which he replied in the negative. In 1790 he was appointed a physician to the Foundry Dispensary, in which connection he remained till the year 1798. In 1793 he was chosen a fellow of the Royal Society; and in 1800 he became physician of St. Thomas's hospital, having been assistant physician from the year 1798. In the year 1800 he was seized with a slight fit of apoplexy; but by adopting a very abstinence mode of living, he escaped any subsequent attack. From this time, however, his health declined.

In 1812 he commenced some experiments on dew, and after he had an opportunity of pursuing them, he wrote an "Essay on the Subject," which was published in August 1814, the year in which he was admitted into the Royal Society of Edinburgh; and in 1816 the Royal Society of London adjudged to him the honour of the gold and silver medals of count Rumford's donation for this essay. Although from the year 1814 to the commencement of his last illness his health was in some respects improved, he was afflicted with painful and threatening symptoms. These symptoms became gradually more alarming; and though in his last illness some hopes were entertained by his medical friends, Dr. Baillie and Dr. Lillie, of his recovery, yet on the 8th of August he was suddenly seized, while he was sitting up, with the sensation of a tremulous motion in the chest, which he referred to the heat, from which time his illness intermitted. After this, says his biographer, "an expectation was entertained of his recovery. His life was continued until the evening of the 18th of September 1817; and until the near approach of its termination, his mind was clear and active, and his spirits calm and cheerful."

Our limits will merely allow our enumerating his principal publications. Of his political papers we shall only mention one, which was written in 1781, by the desire of the commander of the garrison of Charlestown, general Nefbit Balfour. The object of this paper was to shew, by military usage, and the nature of the cafe, that perons in the American service who, after having been taken prisoners and sent to their homes under their military paroles, and who appeared again in arms against the British government, subjected themselves to the punishment of death. This paper was frequently published in the newspapers, and it is probable that it was owing to this publication that general Balfour and lord Moira thought themselves justified in putting to death a colonel Haynes, the propriety of which act was afterwards a subject of debate in the British parliament. The philosophical pieces of Dr. Wells were the following: viz. "An Essay upon single Vision with Two Eyes," 1792, (see Vision, in the Addenda); "Two Letters, in reply to Dr. Darwin's Remarks in his Zoological upon what Dr. Wells had written in his Essay upon Vision, on the apparent Rotation of Bodies which takes place during the Giddiness occasioned by turning ourselves quickly and frequently around," 1794, contained in the Gentleman's Magazine for September and October; "A Paper upon the Influence which incites the Muscles to contract in Mr. Galvani's Experiments," 1795; "Experiments upon the Colour of the Blood," 1797; "Some Experiments and Observations on Vision," 1811; all published in the Philosophical Transactions. "An Essay upon Dew," 1811. In this essay the author has introduced new facts and ingenious observations, of which we shall give some account in our additions to the article Dew. "An Answer to Remarks in the Quarterly Review upon the Essay on Dew," and "An Answer to Mr. Prevost's Queries respecting the Explanation of Mr. B. Prevost's Experiments on Dew," 1815; "A Letter to Lord Kenyon relative to the Conduct of the Royal College of Physicians of London, posterior to the Decision of the Court of King's Bench, in the Case of Dr. Stanger;" "A short Letter on the Condenation of Water upon Glass," 1816; which three last appeared in Dr. Thomson's Annals of Philosophy. "Some Biographical Sketches by Dr. Wells" appeared in the Gentleman's Magazine.

Almost all his writings upon medical subjects are contained in the second and third volumes of the Transactions of a Society for the Promotion of medical and chirurgical Knowledge; and their subjects are,—erysipelas, the entire want of hair in the human body; the dropy, which succeeds scarlet fever; amurium of the aorta attended with ulceration of the œosphagus and wind-pipe; epilepsy and hemiplegia, apparently produced by a sharp projection from the inner table of the skull; tetanus; amurium of the aorta, communicating with the pulmonary artery; enlargement of the coxum and colon; gangrene of the cellular membrane between the muscles and skin of the neck and chest; rheumatism of the heart; red matter and serum of the blood in the urine of dropy, which has not originated in scarlet fever; and observations on pulmonary consumption and intermittent fever, chiefly as diseases opposed to each other, &c.; to which may be added, a case of aphonia lapsmodia, in the second volume of Medical Communications. His manuscript papers were directed to be destroyed, with the exception of one, relating to the difference of colour and form between the white and negro races of men, which will be published.

The literary productions of Dr. Wells have sufficiently established his reputation as a learned and skilful physician, as an acute and inventive philosopher, and as a peripatetic, vigorous, and elegant writer; and it is said, that those who knew him personally esteemed him much more highly than persons who were acquainted only with his writings. His mental powers were strong, acute, comprehensive, and versatile; and he was capable of the most close and long-continued attention, and of directing this attention at pleasure. Although he was not eminently distinguished as a classical scholar, or as a deep mathematician, he had read some of the Greek and most of the Latin classics with great attention; wrote Latin with facility and correctness; and made himself master
mater of the elementary books of the inferior branches of the mathematics. He was well acquainted with natural philosophy, and particularly optics, and also with the facts of modern chemistry; he was an acute metaphysician, and intimately versed in the theories of morals and politics, in ancient and modern history, commerce, and political economy; he had successfully studied belles lettres, and was familiar with the best writers in the English language; and his own style was pure, perspicuous, and occasionally forcible and elegant. In conversation he was instructive and interesting; and in active life prompt and decisive, and at the same time prudent and cautious. In his habits and manners, he was indefatigable in his application; frugal, and yet as far as his circumstances would allow liberal; high-minded, but sensible of obligation and grateful for kindness; retentive, yet placable; irascible even on trivial occasions, but exercising self-command under great provocations when the importance of circumstances and propriety required it; indigent at involuntary and oppression, and regardless of all personal inconveniences in expressing his resentment, but submissive to the appointments of heaven, and calm and cheerful under the sufferings which flowed from them. "A season of duty," says his biographer, "was the paramount feeling of his mind, to which other passions gave way, and which danger and difficulty served only to make more active and vigorous." Such is the tribute which has been evidently dictated by a friend; and yet we have reason for being assured that it is, upon the whole, such as the merit of Dr. Wells justly claimed. Gent. Mag. for November 1817.

Wells, in Geography, a city of SomERFIEHIRE, England, is situated in the hundred of Wells-forum, at the distance of 18 miles from Bath, 21 miles from Bristol, and 121 miles W. by S. from London. It is said to owe its origin to a remarkable spring called St. Andrew's well, the waters of which were supposed to polish extraordinary medicinal properties. There are recorded to have been highly beneficial to Ina, king of the West Saxons, whose religious zeal therefore prompted him to found a collegiate church here in the year 704, and which he dedicated to the above saint. This church was converted into a cathedral in the year 905, when three new bishoprics were confirmed by order of King Edward the elder, and Wells was then made an episcopal see. This was afterwards transferred to Bath by bishop Villala, about the end of the 11th century, who built a palace there, and assumed the title of bishop of Bath. Great contentions soon arose between the two chapters of Bath and Wells, respecting the right of election to the episcopal office. The matter being referred to the arbitration of the bishop himself, it was determined that his successor should take their title from both churches; that an equal number of delegates from both chapters should enjoy the privilege of voting, and that the installation should take place in both cathedrals. This regulation, which was made by bishop Robert, about the year 1135, continued until the reign of Henry VIII., when an act of parliament was passed for vesting the power of election solely in the dean and chapter of Wells. Henceforward the cathedral and episcopal seat have been fixed at Wells, but the title of the bishop is of "Bath and Wells." To the pious zeal of its bishops, the city is indebted for that truly interesting structure, its cathedral church. The building of king Ina having, in the course of four centuries, fallen into a dilapidated state, was about the year 1150 rebuilt on a much larger scale by its bishop. In 1239 it received considerable additions by bishop Joceline, who altered, or fitted up the choir, and made other improvements; the south-west tower was added by bishop Harewell, and other contributors, in 1365; in 1415 the north-west tower was raised by bishop Babwich; and finally, the chapel of the Virgin Mary was added by bishop Beckington, about the year 1445. Other parts of this interesting fabric were erected and adorned by other prelates, but the precise time of these alterations is not recorded. The cathedral, as it now appears, consists of a nave, with two aisles, a transept, and choir, also with side-aisles; at the eastern extremity of the choir is a smaller transept, and the chapel of the Virgin; on the north side is a porch, also a covered passage to the chapter-house and deanery. Over the intersection of the nave and transept is a large quadrangular tower, 165 feet in height, resting on four broad arches, and at the west end are two other towers. The length of the nave is 190 feet; of the choir to the altar, 108; and of the chapel of the Virgin, 52 feet. The whole fabric exhibits specimens of the different styles of architecture which prevailed between the twelfth and fifteenth centuries; but the most interesting part is the west front, certainly one of the most imposing examples of architectural and sculptural workmanship in the kingdom. It is adorned with a great number of niches and canopies, with statues of the apostles, popes, princes, bishops, &c. It is divided into five portions in height by bold buttresses, and four decided compartments, horizontally. In the centre is a large entrance door-way to the nave, over which are three tall lancet-shaped windows; above these is a pyramidal façade to the gable of the roof, crowned with pinnacles, and adorned with numerous niches, statues, &c. The buttresses are likewise covered with panelling, tabernacles, and statues. The interior of the church is full of interest and beauty. Its nave consists of nine clustered columns on each side, supporting pointed arches, over which is a triforium, or open gallery. A third story above this displays a series of windows, which, with the other arches, are most of the lancet-shape. The columns, cross-springers under the roof, and the whole architecture of this part of the church, display the style of the early part of the thirteenth century. In the nave are two elegant monumental chapels, or oratories, to the respective memories of bishops Babwich and Knight. Adjoining the latter is a curious stone pulpit. At the intersection of the nave with the transept is a large central tower, which rests on four solid piers, or clustered columns, supporting four arches, and over which are inverted arches. The choir is richly ornamented, and lighted by fixed highly pointed windows on each side, and a large eastern window over the communion-table. Behind the latter are three open arches to the lady chapel, which is singular in form, decoration, and character. Immediately behind the altar is a circular arrangement of columns, each of which is an abib, forming a half octagon. The whole is surrounded by large windows, with painted glass. In this part of the church are several curious and interesting monuments. North of the great transept is the chapter-house, an octagonal apartment, in the centre of which is a lofty clustered column, from which diverge several ribs.

Southward from the cathedral is the episcopal palace, which has more the appearance of a fortified castle than of the residence of a bishop. It is surrounded by a wet moat, an embattled wall, flanked with semicircular turrets, with a venerable gate-house on the north side. The deanery-house is a spacious quadrangular building; and here are good houses for the prebendaries. The establishment of the cathedral consists of a bishop, a dean, twenty-seven prebendaries, nineteen minor canons, a precentor, treasurer, chancellor, and three archdeacons; a number which few other cathedrals have.
The city of Wells is seated in a valley, surrounded by lofty hills, and has some spacious streets. It was first made a free borough in the reign of Henry II., by the interdict of Joceline, its bishop. It afterwards received a charter from king John, by which it was provided with a weekly market; by queen Elizabeth's charter, the corporation consists of a mayor, recorder, seven masters, and fifteen common-council men. Wells has sent two members to parliament from the earliest period: the right of election is in the mayor, masters, burgesses, and freemen. The voters are about five hundred; the mayor is the returning officer. By the return to the population act of the year 1811, the number of houses is stated to be 530; of inhabitants 4556. Six annual fairs are held here; and markets on Wednesdays and Saturdays. The corporation have a spacious town-hall for the dispatch of their business; where also the assizes are held. Under this hall is an hospital, founded by bishop Bubwith, for the maintenance of thirty poor men and women. Here are several other alms-houses, particularly those endowed by Nathaniel Steal and son, for thirty-two men and women, who are allowed three shillings each per week, with a great-coat for the men, and a gown for the women, once in two years. A charity-school was also erected here for twenty boys and twenty girls, in the year 1714.

Near the village of Wookey, which is situated about two miles north-west from Wells, is a remarkable cavern, called Wookey Hole. In its front is an assemblage of vast rocks, which rise to the height of at least two hundred feet, almost covered with trees and plants springing out of the fissures. On the left side of a deep ravine is a natural terrace, which leads to the mouth of the cavern, and through the middle of it runs a clear rapid rivulet, that rushes out of an arch thirty feet in height, and forty in breadth, impetuously making its way over an irregular bed of rocks. Hence, an opening not more than six feet high, conducts into a spacious vault, eighty feet in height, entirely covered with stalactites. Near this is a similar, though smaller vault; and beyond them, a low passage leads to a space nearly circular, and about one hundred and twenty feet in diameter, with a vaulted roof forty feet in height. Near this area is what the vulgar call the Witch's Brewhouse, where a great number of singular configurations of stalactite are observable, to which correspondent apppellations have been given, such as the boiler, furnace, &c. To the left is what is called the hall, which is very lofty, the centre of the roof being at least one hundred feet above the ground. The whole length of the cavern is supposed to be fix hundred feet.—Collinson's History of Somersetshire, 3 vols. 4to. Maton's Observations on the Western Counties, 1792. Davies's Concise History of the Cathedral Church of Wells, 1809.

Wells, a township of New York, in Montgomery county, erected in 1805 from the N. part of Northampton and Mayfield, bounded by N. by Franklin county, E. by Ellicot, Washington, and a small part of Saratoga county, S. by Northampton and Mayfield, and W. by Johtnstown, about fifty-five miles long and eight miles wide. The country is rough and mountainous, and the soil light, sandy, and barren. It has numerous lakes and ponds, which abound with trout and other cold-blooded fish, affording good food as well as sport for the angler. Peeseke lake bears the name of an Indian, and lake Pleafant is a pleasant lake, with a fine beach of white sand.

Wells, a sea-port town of England, in the county of Norfolk, with a harbour at the mouth of a small river, of difficult access, on account of the shifting sands at the entrance. The chief trade is in corn, malt, and coals; and of late an oyster-fishery has been established: it has no market.

The population in 1811 was 2683. Near on the W. of Wells is Holkham-hall, the magnificent seat of T. W. Coke, esq. M.P. Wells lies 118 miles N.E. from London.—Alfo, a town of West Florida, situated on the W. side of St. Andrew's bay. N. lat. 30° 25'. W. long. 85° 50'.—Alfo, a town of America, in the district of Maine, and county of York, at the bottom of a bay to which it gives name, between Capes Porpoise and Neddk, containing 4489 inhabitants: 20 miles S.W. of Portland. N. lat. 43° 20'. W. long. 70° 32'.—Alfo, a town of Vermont, in the county of Rutland, containing 1040 inhabitants: 10 miles S.W. of Rutland.

Wells, a river of Vermont, which runs into the Connecticut.

Wells's Creek, a river of Kentucky, which runs into the Ohio, N. lat. 38° 47'. W. long. 84° 27'.

Wells's Falls, a cataract in the river Delaware; 13 miles N.W. of Trenton.

Wells's Passage, an inlet on the west coast of North America, branching off from Broughton's Archipelage.

WELMICH, or SELMENACH, a town of Germany, in the circle of the Lower Rhine, on the right bank of the Rhine; 1 mile from St. Goar.

WELMINA, a town of Bohemia, in the circle of Leitmeritz; 5 miles W. of Leitmeritz.

WELVAR, a town of Croatia; 16 miles S.E. of Crevitz.

WELP, a town of Bohemia, in the circle of Koniggratz; 3 miles S.E. of Toplitz.

WELPSHOLTZ, a town of Germany, in the county of Mansfeld, memorable on account of a victory which Lothario, duke of Saxony, obtained over Henry V. in the year 1115.

WELS, a town of Austria, on the river Traun. This is supposed to have been an ancient town of the Norici, and by the Romans called Ovilara, or Ovilaha. Others say it was built by the emperor Valerian after his expedition against the Scythians in Pannonia. The emperor Maximilian I. died here; 11 miles S.S.W. of Lintz. N. lat. 48° 10'. E. long. 14°.

WELSCH, a river of Thuringia, which runs into the Unilutt, near Thomaibuck.

WELSBACH, a river of Frankton, in the department of the Sarre; 18 miles N.N.E. of Luxembourg.

WELSCHBIRKEN, a town of Bohemia, in the circle of Prachatitz; 6 miles N.N.W. of Prachatitz.

WELSE, a river of Brandenburg, which runs into the Oder, near Vierraden.

WELSH CLAIVE, or BILL, in Military Antiquities, a kind of bill, sometimes reckoned among the pole-axes, which was formerly much in use.

WELSPPOOL, or TRALLWS, a large and populous market-town, partly in the hundred of Pool and partly in that of Caerw, in the county of Montgomery, North Wales, is situated on the bank of the river Severn, 8 miles N. from the county-town, and 169 miles N.W. by W. from London. It consists of one long and spacious street, with another smaller, crossing it at right angles, and several other collateral branches of lesser dimensions; and is the largest and best-built town in the county. From the manners and language of the inhabitants, it has every appearance of an English town; the Welsh being spoken here by few persons. An air of urbanity and opulence pervades the place, chiefly owing to the intercommunication with the more polished parts of the kingdom, and to the extensive trade in flannels; great quantities of which are manufactured here.
here, and still greater brought from the hill countries. This being the principal mart for that article, a market is held on every alternate Monday for the sole purpose of exposing it to sale. A weekly market is also held on Mondays for provisions; and here are six annual fairs for horses, sheep, and cattle. The Severn becomes navigable at a small distance below the town, at a place called the Pool-flake; and a branch of the Ellesmere canal running near, tends to facilitate carriage by water conveyance. Among the recent improvements made in the town, is the county-hall, erected at the expense of a few private gentlemen. This structure, with a colonnade and piazzas of stone in front, consists of upper apartments for the administration of justice, and of lower ones for the accommodation of trade. Beneath is a spacious place, appropriately as a corn-market; a separate space for the sale of miscellaneous articles; and an ample court for holding the assizes or great sessions. On the second floor is the county-hall room; and a handsome room adjoining is fitted up for the use of the grand jury. The church, though in the pointed style, is apparently of no very remote antiquity. It stands singularly at the bottom of a hill, and is so low, that the ground of the cemetery almost equals the height of the building. Among the sacramental utensils is a chalice of pure gold, brought from Guinea on the coast of Africa, containing a wine quart: it bears a Latin inscription, stating that its intrinsic value was £68, and that it was presented to the church in the year 1562 by Thomas Davies, some time governor-general of the English colonies on the western coast of Africa. Welsh-Pool has a very ancient corporation: its original charter was granted by one of the princes of Powys Land, about the end of the eleventh century; the present was a grant from Charles II., by virtue of which the town is governed by two bailiffs, a high reefer, recorder, and town-clerk; under whom are two serjeants at mace. The population of the parish, which includes nine adjoining townships, was in the year 1811 returned to parliament as 2779; the number of houses as 578. Formerly the town contributed with the borough of Montgomery in sending a member to parliament; but was disfranchised of this privilege in the year 1728. There are some encampments in this parish, one of which is said to have been the British camp of Caractacus, on the summit of the Brydgen-hill, where the last remains of ancient British liberty were lost by the surrender of that brave sovereign: on the centre of this mountain a column was erected, to perpetuate the memory of admiral Rodney's celebrated victory over the French fleet in the West Indies, April 12, 1782.

About a mile to the southward of Welsh-Pool, is Powys Castle, formerly the chief mansion of the Conwilian Welsh princes of Powys, and now the residence of the earl of Powys. This venerable pile, situated in a well wooded park, is built in the ancient style of domestic architecture, participating of the castle and manor. The entrance is by a gateway between two massive circular towers, into the area or court, round which the apartments range. Several other towers are still standing, flanked with semicircular bastions. In front, two immense terraces, rising one above another, form the ascent, by means of a vast flight of steps. The interior exhibits little worthy of notice, excepting the principal gallery, measuring 117 feet in length, which was originally much longer; but in the modernizing plan a large room has been taken from it. The park is formed of spacious lawns, and swelling hills; the oak, beech, and chestnut, diversify the views in rich variety; and highly contribute to render the place interesting to the lovers of forest scenery. It is, however, to be regretted, that this venerable castle is verging to decay: the buildings are in a state of dilapidation; the gardens and grounds are neglected; and the pride and ornament of the park, removing, for the sake of the timber; so that at no very distant period, the beauty and magnificence of Powys may be no more. — Beauties of England and Wales, vol. xvii. North Wales. By Rev. J. Evans, 1812.

WELSTEIN, a town of France, in the department of Mont Tommerre; 7 miles E.S.E. of Creutznach.

WELSUN, a town of the duchy of Guelderland; 6 miles W. of Hattem.

WELT-Roist, in Agriculture, a term that signifies the dying away or falling off of wheat-crops, in some cases, in the winter or early spring feareons. It has been supposed to occur the most frequently where the wheat-crops have been put in on clover-leys. Some incline to think that it depends upon the want of a sufficient degree of eolofens and firmness in the on the beds of mould into which the crops have been put; as where they lie too open and in too porous a state, due nourishment and support is not supplied to the young wheat plants from below, that, of course, they do not form their roots in a proper manner. See Treading.

The term is also applied to an operation in the harvesting of grain. See Root-Welt.

WELTENBURG, in Geography, a town of Bavaria, on the right sife of the Daunbe; 20 miles E.N.E. of In
goldstadt.

WELTERSBURG, a town of Germany, in the county of Leningen; 1 mile S. of Welfenburg.

WELTENEN, a town of the duchy of Weftphalia; 5 miles N. of Werl.

WELWARK, a town of Bohemia, in the circle of Schlan; 8 miles N.E. of Schlan. N. lat. 50° 18'. E. long. 14° 24'.

WELWIN, a village of England, in the county of Herts, where the general massacre of the Danes is said to have begun in 1012. In this place, Dr. Young, who was the rector, wrote his celebrated Night Thoughts. Here is a chalybeate spring; 25 miles N. of London.

WELZHEIM, or WELZEN, a town of Wartenburg, and capital of a lordship to which it gives name, on the Lein; 20 miles E. of Stuttgart.

WEM, a market-town of Whitechurch division of the north part of the hundred of Bradford, in the county of Salop, England, is situated near the source of the river Roden, at the distance of 7 miles S. from the town of Whitechurch, 10 miles N.E. from Shrewsbury, and 172 miles N.W. from London. From its situation Horley infers, that it is the scite of the ancient Rutunium. The manor was formerly in the possession of the earls of Arundel, but on the attainder of earl Philip, in the reign of queen Elizabeth, it fell to the crown; and James I. conferred it on the lord chancellor Jefferies, of infamous memory, who had the estate, and was created baron of Wem. On his death, the title descended to his son; but on his decease, which occurred shortly after, it became extinct. The town of Wem consists of one large street, with a few smaller ones. By the population return of the year 1811, the number of houses was stated to be 297, and the inhabitants 1395. A weekly market is held on Thursdays, and three fairs annually. The church, a rectory of the real value of about 500L. per annum, is a handsome edifice, with a lofty tower, and a fine chancel. A free-school was founded and liberally endowed by Sir Thomas Adams, who was born in this town in the year 1586, and was elected lord mayor of London in 1635. He was an inflexible adherent to king Charles I. in his troubles, and
continued his attachment to Charles II, while in exile, to whom he is said to have made a remittance of 10,000l. On the eve of the Restoration he was deputed by the corporation of London to go with general Monk to Breda, to conduct the king to England. The munificence and charities of Sir Thomas were exemplary among other memorials, is an Arabic professorship founded by him in the university of Cambridge. He died February 24, 1667, in the 81st year of his age. Near this town, in 1640, was born William Why- cherley, a celebrated dramatic writer, who died January 1, 1715. In the same house which gave him birth, was also born John Ireland, author of the "Illustrations of Hogarth," and otherwise well known in the literary world. — Beauties of England and Wales, vol. xiii. Shropshire. By Rylene, and J. Nightingale, 1811.

WEMBDINGEN, a town of Bavaria; 10 miles E. of Nordlingen. N. lat. 48° 51'. E. long. 16° 40'.

WEMBERG, a town of Bavaria, in the landgraviate of Leuchtenberg; 6 miles S.W. of Leuchtenberg.

WEMDALEN, a town of Sweden, in Hardjeadal; 67 miles full of Sundswall.

WEMISTITZ, a town of Moravia, in the circle of Znaym; 4 miles S.W. of Kruman.

WEMMERBY, a town of Sweden, in the province of Smalad; 50 miles N. of Calmar.

WEMO, a town of Sweden, in the government of Abo; 22 miles N.W. of Abo.

WEMYSS, a sea-port town of Scotland, in the county of Fife, on the N. side of the Firth of Forth; a harbour of barony governed by bailies and a council: it has a good harbour, and several vessels belong to it, chiefly employed in the carrying trade. Coals and salt are the only exports; 4 miles N.E. of Kirkcaldy. N. lat. 56° 9'. W. long. 3° 4'.

WEMYSS, East, a town of Scotland, in the county of Fife, on the coast, but without a safe harbour: here are the ruins of a castle usually called Macduff's Castle, said to have been built by Macduff, who was created Earl of Fife, in 1107, by Malcolm Canmore; 5 miles N.E. of Kirk- caldy.

WEN, in Surgery, an encysted swelling, the particular nature of which is described in the article TUMOURS. See also Atheroma, Melicemia, and Steatoma, which are technical names applied to the three principal varieties of encysted tumours. Scarpio's observations on encysted swellings of the eye-lids, will be found in another place. See Eye-Lid.

Wen, in Animals, a fleshy substance growing out of any part of an animal's body, and which not infrequently proceeds from bowels, bruises, strains, and other slight accidents of the same nature, most commonly beginning or taking its origin in the skin of some part, and gradually enlarging by a continual accumulation in the diseased part, until by time it becomes of a very considerable size in some cases. Enlargements of this nature are seldom painful, and in many instances they are of several years duration before they ever reach any great magnitude; becoming quite indolent and somewhat like the natural flesh, having rarely any other sensible effect than that of causing a deformity and weight in the parts where they happen to be situated. The substance of them is, for the most part, of a fleshy and often spongy nature, though, in some cases, there is a kind of sponginess mixed with a degree of hardness, and occasionally a florid or cancerous disposition accompanies them, especially when they take place in the neighbourhood of parts which are of the more glandulous kind.

In most real cases of this nature, the wen is contained in a sort of cyst or bag, which arises from the injured vessels of the part, and is formed as it slowly advances; and which incloses the whole substance, augmenting in thickness as well as size as it increases.

In the removal and cure of cases of this sort when they make their appearance on any part of an animal's body, trials should first be made to diffolve and difperse them by proper means, such as camphorated spirituous and mercurial applications; and where this cannot be accomplished, as is often the case, the use of the knife or cautic must be had recourse to for the purpose of taking them off or destroying them. In circumstances where the wens are of the pendulous sort, and hang only by a small neck root, they may frequently be easily and conveniently removed by the use of a ligature of the same kind as is employed in taking up large blood-vessels, applying it so as that it may be capable of being gradually made tighter as there may be occasion, until the substance drops off; the part being afterwards dressed and healed by the common digestive ointment or cerate. Bathing and washing the part frequently with the tincture for wounds is also, in some cases, of great utility.

See TUMOUR, and WOUND, in Animals.

However, in cases where wens have large broad-bottom root parts which are of a knotty spongy nature, the cure, if practicable, is to be attempted by extirpation, or the use of rather mild caustics, dresting the parts as in the case of wounds. It is sometimes the best and safest practice, however, to meddle as little as possible with wens of this sort.

When enlargements of the wemy kind take place on the legs and heels of animals, as is often the case in the horse, in the more simple kinds of them, the cure may be sometimes effected by the use of applications such as hot vinegar and alum; but in case bloody matter be extravagated, suppuration should be promoted by the use of stimulant ointments and washes, and the parts be opened when proper by means of a lancet in a suitable depending situation, the openings being dressed by the wound ointment and tincture.

In these wemy enlargements, the contents are of different kinds, sometimes watery, and at others of a fibrous or thick puffy nature; which, if care be not taken to digest well out, together with the cyst, will not infrequently collect and fall again. In some instances, the shortest method would be to extirpate them by means of the knife, which, when well performed, and the skin properly preferred, would leave little deformity. However, some of these sorts of enlargements are best let alone, as those of the watery kind in particular, which will wear away insensibly in many instances, without any application except a little camphorated mercurial ointment.

WENS of Pearl. See Pearl.

WENBACH, in Geography, a river of France, which runs into the Rhine, 3 miles above Drafenheim.

WENCESLAUS, or WENCESLAUS, in Biography, the son and successor of Charles IV., whom he succeeded as emperor of Germany and king of Bohemia, in his 15th year. In the progress of his life, he became notorious both for cruelty and debauchery, and for the most extravagant profusion, for the means of which he had recourse to the most flagitious conduct.

His extravagance, however, became at length so intolerable, that the Bohemians, in 1396, with the advice of his
his brother Sigismund, king of Bohemia, put him into confinement; from which he contrived to escape, and again to assume the royal authority. But as he pursued the same conduct, his brother Sigismund, at the request of the people, deposed him, and he was declared regent. Weneclaus, after having been confined successively in various prisons, made his escape from one of the towers of Vienna, and returning to Prague, recovered his kingdom. After a second marriage, his extravagance involved him in new difficulties, so that, in order to his dimbarrassment, he was under a necessity of selling his imperial rights to John Galeazzo, who had seized the sovereignty of Milan, and other cities of Lombardy dependent on the empire. The princes of the empire became indignant, and assembled a diet in 1400, in which they formally deposed him. Professing himself happy at this event, which would afford him leisure to pay attention to the government of his kingdom, he held the crown of Bohemia for 19 years longer, more tolerable in his vices, though still unreclaimed from them. The disturbances of Bohemia, occasioned by the preaching of John Hufs, occurred in his time, and he took pains to compose them. At length, whilst he was sitting at dinner, he received intelligence of a sudden tumult at Prague, which occasioned a paroxysm of rage, that was followed by an apoplexy, which terminated his life in 1419, at the age of 58. Mod. Un. Hist. Morav.

WENDEL, in Geography, a town of Sweden, in Upland; 
15 miles N. of Upfal.

WENDEL, a town of Sweden, in Harjeadalen; 
18 miles S.E. of Langachants.

WENDELL, a township of Massachussets; 90 miles 
N.W. of Bolton—Alfo, a township of New Hampshire, 
in the county of Cheshire, containing 447 inhabitants; 30 
miles N.W. of Concord.

WENDELSTEIN, a town of Germany, in the 
principality of Anpach; 8 miles S. of Nuremberg. N. lat. 
48° 19'. E. long. 11° 4'.—Alfo, a town and ruined 
citadel of Thuringia; 6 miles S.W. of Querfurt.

WENDEN, a town of the duchy of Weffphalia; 
4 miles S. of Olpe—Alfo, a town of Prufia, in the 
province of Bartenland; 6 miles N. of Raftenburg.

WENDIA, in Botany, a new unbilliferous genus, thus 
named by profefor Hoffmann, in honour of Dr. Wendt, 
profefor of Phyfic at Erlang, counfessor to the Efector 
Palatine, and succeflor to the great Schreber in the 
diflinguifhed fitude of Prothon of the Imperial Academy Na-
ture Curiforium. He is celebrated for the numerous obfervations 
which he has publifhed, refpeéting medicinal plants, and 
for his zeal in the promotion of botanical studies in general. 
hoffm. Gen. Plant. Umbellif. v. 1. 136. t. 1. B. f. 8, a, 
b.—Clafs and order, Pentaftria Digynia. Nat. Ord. Um-
bellata, Linn. Umbellifera, Juff.

Gen. Ch. Cal. General involucrum none; partial of a few 
short, unequal, lanceolate or linear, deciduous leaves. Per-
ianth of five unequal teeth, two of them, in the radii flo-
rets, twice as large as the red, ovate, acute. Cor. Univer-
fail regular; flowers of the radius perfect, fertile, except a few 
males which are interperfed; partial of five petals, with 
long claws; the outer ones in the radius very large, the mid-
dle one divided almost half way down into two discriminated, 
linear-oblong, obtruse, slightly falcate, equal lobes, lateral 
ones rather smaller, unequally cleft, falcate, one lobe three 
or four times the length of the other; inner ones much the 
smaller, about equal to the petals of the disk, two-lobed 
from their incurvation, their point ovato-lanceolate, acute, 
channeled. Stam. Filaments five, fimple, equal, spreading,

the length of the smaller petals longer than the petals in 
the flowers of the disk; anthers nearly ovate, two-lobed. 
Pfl. German oval, comprefed, friterated, hairy; fyles two, creft, 
at length widely fpreading, tapering, their date conical, 
winged with a membranous criped border running down 
each ftyle; fignum capitute, obtufe, at length somewhat 
globular. Peric. Fruit almoft perfectly fmoth, ovo-
ate, nearly orbicular, comprefed, bordered, friterated and 
striped, entire at the edges. Seeds two, uniform, emarginate, 
crowned, in the terminal notch, with the conical, winged, 
feudulate base of the two defixed permanent fyles: dorft ribs 
three, flobber, slightly elevated, converging at each end; 
margin ones two, parallel; ftries four, defending from 
the top of the feed between the ribs, obtufe, club-shaped, 
bowfhit, not half the length of the feed: border convex, 
terminating in a thin, flat, sharp edge, which is channelled 
externally, emarginate at the bottom.

Eff. Ch. General involucrum none; partial obftolute. 

Flowers radiant. Calyx unequally toothed. Fruit nearly 
orbicular, comprefed, notched, with three ribs, and four 
short intermediate ftries; crowned with the fyles, whose 
base is winged.

Obf. The want of a general involucrum, and the flight-
exfs of the partial one, added to the more orbitcular form 
of the seeds, and their smoothnefs, appear to afford the chief 
marks of diftinction b-tween this genus and Heracleum, 
(see that article,) from which we fhould be rather unwilling 
to separate it, any more than Sphondylum.

The only species mentioned by the author is,


n. 1. (Heracleum longifolium; Marfch. & Biebr. Taur. 

Cauc. v. 1. 223, excluding all the fynonyms).—Native of 

the graffy declivities, surrounding the Caucasian mineral 

waters of Nartfana, flowering in July. The root is bi-

enial. Leaflets two pair with an odd one. General and 

partial involucrum scarcely difciferm. Flowers snow-white; 

thofe of the radius remarkably unequal. Seeds when bruised 

agreeably fragrant. The author of the Flora Taurico-

Caucasica fays, he thinks this more akin to Heracleum Sphon-

dylum, with which Crantz and Lamarck unite it, than to 

the anguifolium of Jacquin, to which it is referred by Will-

denow. The latter, however, proves to be a different 

plant, and it is probable that Willdenow had no knowledge 
of Hoffmann's Wenda, any more than Jacquin, Crantz, 

or Lamarck, all their obervations referring to the real H. 

longifolium of Fl. Taur. c. 174.—The specific name, 

coquifolium, is an old fynonym of the Sphondylum, or Cow-

parnip.

WENDING, at Sea, a term for bringing a fhip's head 

about, and seems only to be a corruption from wending.

They fay, How wends the fhip? 

WENDLANDIA, in Botany, owes its name, though 

not its diftinction as a genus to the late profefor Willde-

now, who dedicated it to the author of that diftinction, Mr. 

John Christianef Wendaef, curator of the royal garden at 

Herrenhauen, "a noft acute botanif, and highly meritos-

or writer," His name appears in the Sertum Hannoveran-

um of the very eminent profesor Schroder, as the deli-

nator and engraver of the plates of that work. These dif-

play great botanical skill and attention.—Will. Sp. Pl. 

v. 2. 275. Purf. 252. ("Androphytus; Wendland 

Obf. 37".)—Clafs and order, Hexandria Hexasynyla. 


reclining. Captufes fix, of one cell. Seeds felforty.


n. 1.
WEN


Proser in De Candolle has referred this plant to his genus *Coccus*, separated from *Menispernum,* (see that article,) on account of the flowers being three-cleft, not four-cleft, to make the Linnaean language; and the lamens only five, instead of from six to ten to twenty. We cannot but hesitate to adopt a genus fo circumstances, and therefore shall say little concerning the name, which its antiquity can hardly authorize. We regret to perceive that our learned friend feels inclined to make antiquity paramount to every other consideration in nomenclature; thus assuming a principle subservient of all his own authority, which otherwise might be of sufficient weight to render the most important service to this branch of botany. We hope he will soon perceive, that sense and learning are as applicable to it as to any other part of the science, and full as necessary to prefer the whole from ruin.

If the name of *Coccus* should be disfavored, though the genus be retained, still that of *Wendlandia* can scarcely take its place; there being several others, good or bad, certain or uncertain, which have a prior claim on the score of antiquity. With these we will not here enumerate our paper. The reader may find them in De Candolle.

WENDLING, in Geography, a town of Austria; 3 miles W. of Taufkirchen.

WENDLINGEN, a town of Wurttemberg, on the river Lauter, near the Neckar; 12 miles S.E. of Stuttgart. N. lat. 48° 38'. E. long. 9° 27'.

WENDOVER, an ancient borough and market-town in the hundred of Aylebury, and county of Buckingham, England, is situated in Aylebury Vale at the distance of 24 miles S.E. by S. from the county-town, and 35 miles N.W. by W. from London. It consists principally of brick houses; the inhabitants derive their chief support from lace-making; but as a branch of the Grand Junction Canal has been recently conveyed to the town, it will probably advance in importance. The earliest charter for a market at this place was dated in 1403. A subsequent charter of the year 1464 confirms the market, and grants two fairs, which are still held. This borough sent members to parliament in the 28th of Edward I., and again in the 1st and 2d of Edward II.; after which the privilege was disfranchised for above three hundred years; when in the 21st of James I. Mr. Hakeville, a barrister of Lincoln's-Inn, discovered, by a search among the parliament writs in the town, that members had been formerly sent. A petition was accordingly preferred for the restoration of the ancient franchise; and though strenuously opposed by the court, the commons decided in favour of the borough. The right of election is vested in all the housekeepers not receiving alms. The voters are not however more than 130, most of whom occupy the burgage houses rent free. The celebrated John Hampden represented this borough in five parliaments. In the population return of the year 1811, Wendover is stated to contain 283 houses, and 1461 inhabitants. The parish-church stands a quarter of a mile from the town, and contains nothing worthy of particular notice. Near the town is a large reservoir of water, which covers about seventy acres; it was made for the supply of the canal. — Beauties of England and Wales, vol. i. Buckinghamshire; by J. Britton, and E. W. Brayley, 1861. Lysons's Magna Britannia, vol. i. Buckinghamshire, 1866.

WENFORD, a town of Sweden, in West Bothnia; 25 miles N.W. of Umea.

WENG, a town of the duchy of Styria; 10 miles N.E. of Rottenmann.

WENOIA, a town of Sweden, in West Gothland; 32 miles E.N.E. of Gothenburg.

WENHAM, a township of Maffachusetts, in the county of Essex, containing 554 inhabitants; 21 miles E.N.E. of Boston.

WENHOFDORF, a town of Austria; 5 miles N.W. of Schwannmaier.

WENJAN, a town of Sweden, in Dalecarlia; 44 miles W.N.W. of Falun.

WENIGZELL, a town of the duchy of Styria; 11 miles W.S.W. of Fridberg.

WENINGS, a town of Germany, in the county of Hauen, 4 miles N.W. of Birlefin.

WENLOCK, GREAT, or MUCH, a borough and market-town in the hundred of Wenlock, and county of Salop, England, is situated 14 miles S.E. from Shrewsbury, and 147 miles N.W. from London. It is but poorly built, and consists of only two streets, but contains an ancient corporation, and is said to have been members to parliament, by a writ from Edward IV. in 1478, when it sent one member; but now, jointly with Broseley and Little Wenlock, it returns two. The free burgesses who are the electors, amount to one hundred and ten. By a charter from Charles I., the corporation consists of a bailiff, recorder, two justices of the peace, and twelve capital burgesses. The whole number of the inhabitants, by the population return of the year 1811, is enumerated as 2079, occupying 494 houses. Four annual fairs are held here; and a weekly market on Mondays. In the reign of Richard II., Wenlock was as famous for copper-mines, as it is now for quarries of lime-fone. The parish-church bears some marks of Norman architecture. A large round arch separates the nave from the chancel: at the west end is a square tower, with circular headed windows, from which rises a slender spire of wood, covered with lead. The interior is well fitted up: on the right of the altar are some niches; but there is no monument of sufficient antiquity or sculpture to attract the notice of the antiquary. Wenlock owes its celebrity principally to the remains of an ancient abbey, which was subsequently converted to a priory for Cluniac monks. This house was founded about the year 680, by St. Milburga, daughter of Merward, and niece of Walphee, king of Mercia; she presided as abbess, and died about the year 716. The Danes ravagers are said to have reduced this monastery to a state of utter desolation, in which it lay until Leofric was appointed to the earldom of Mercia. Soon after the year 1017, that earl, at the instance of his pious comfort the lady Godiva, restored it; but with few additions, that, according to Malmesbury, it was found an heap of ruins, by Roger de Montgomery, the first Norman earl of Shrewsbury, who rebuilt it in 1080, and filled it with monks from Cluny.
It is certain that none of the existing remains are older than his time; and these are confined to the chapter-house; for not a vestige is now to be traced of the pillars of the choir, which are known to have been circular, massive, and Norman. The parish-church was indeed rebuilding at, or just before the time when Malmbury wrote (about 1127); for it was on the occasion of commencing the building of the new church, that the discovery was made of the body of St. Milburga, whose sacred relics are said to have effected many miraculous cures. The parish-church still retains evident marks of having been erected at a period consistent with this narrative: but no part of the priory, except what has already mentioned, can lay claim to any such antiquity. The remains of the patron saint appear to have been transferred from the church of the parish to that of the priory, and perhaps some new works erected with the treasuries which pour in from their fortunate discovery; for when Gervase Paganel resolved to build a priory at Dudley, which he appears to have done early in the reign of King Stephen, "he placed his deed of gift with his own hand upon the altar of St. Milburga of Wenlock, in presence of all the convent, to whose protection he committed his new foundation." Indeed the priory of St. Milburga was in such high repute for sanctity of life and strictness of discipline during this century, that in 1164 it furnished a colony of monks for the abbey of Paisley in Clydevald. The number of monks maintained within the priory was forty, and the same appears to have been about the original number of stalls in the chapter-house: though in 1374, when an inquiry was instituted into the state of the alien priories, it was found to contain only seventeen monks. The priory was surrendered January 31, 1539-40, when a pension of 30l. per annum was settled upon the prior, John Creffield, and the manor-house of Madeley was assigned for his residence. The revenues of the monastery, according to Dugdale, amounted, at the time of the dissolution, to 401l. or 7½d. The site was granted by Henry VIII. to one Augustino de Augustainis, who sold it, in 1545, to Thomas Lawley, esq., who made it his residence, and in whose descendants it continued, till Robert Bertie, esq., son of his great-granddaughter Ursula Lawley, by Sir Robert Bertie, K.B., sold it to the family of Gage. Lord Viscount Gage alienated it to Sir John Wynn, bart., who devise this with his other great estates, to his kinman Sir Watkin Williams, bart., who thereupon assumed the name of the testator: he was grandfather of Sir Watkin Williams Wynn, bart., the present proprietor of these venerable ruins.

Few of our English monastic remains, perhaps, are capable of affording more instruction and amusement to the lovers of ecclesiastical architecture, than those of Wenlock. The ruins are seated in a low marshy bottom, southward of the ancient borough, and adjoining the east end of the parish church-yard. The chief entrance to the monastery, from the town, was by a gate on the north side of the precinct, which appears to have been flanked with two plain square towers, one of which is standing. The most prominent features of the present buildings, are the lofty and extensive remains of the priory church, which have happily escaped the ravages of time. From these it is apparent that this sacred edifice partook of the mixture of the round and the pointed arch. Its magnificence fully corresponded with the opulence of the foundation, and was not surpassed by many of the flately churches of the mitred abbeys. The plan of the church was cruciform, with a central tower, but probably without towers at the west end. The extreme length was 401 feet; that of the transept 166; the nave 156; the space under the fleeeple 39; the choir 156; and the chancel of the Virgin Mary 48. A fragment of the south angle of the west front is ornamented with three tiers of small arches: a window below is finished with a plain round arch. The great west window is now no more, but from the remains of one of its impolls, which is a taper-clustered pilaster, bound midway with rings, its form may be conjectured to have consisted of three lofty lancet-arches. Three pointed arches on the south side of the nave are perfect, and rest on strong octagonal pillars with plain capitals. Over these commences a second division, separated by an horizontal string-course; this comprises a beautiful triforium, or open gallery, formed by lancet arches in couples. Above these is a third compartment, from which rife a series of pointed clerestory windows, now mutilated, but evidently in the same style with the arches of the gallery beneath. A considerable fragment of the north, and the whole of the south wing of the transept are standing, both in a style coeval with the nave. The latter, a very beautiful ruin, is composed of three pointed arches on each side, resting on clustered columns, with plain but well-executed capitals. The bafes of the four grand piers, which supported the fleeeple over the interference of the nave, transept, and choir, may be traced nearly buried in rubbish; and evident vestiges of clustered shafts indicate that they sustained pointed arches. Of the choir, scarcely a wreck remains, yet within these few years, the lower members of the fix pillars, of plain and maily Norman architecture, might be discerned. Further eastward appears the foundation of the Virgin Mary's chapel, consisting of excellent masonry, with several deep basement mouldings. On the eastern side of the quadrangle was the chapter-house, a parallelogram of sixty feet by thirty, of which a very large portion is standing; and a more rare display of Norman architecture of the eleventh century can hardly be produced. The north side is almost entire. A few paces southward of the chapter-house are the remains of a second quadrangle, the buildings of which, on two sides, are nearly entire. Thence on the eastern side, it is prefixed, belonged to the lodge of the priory, and, at the dissolution, were preferred for a manion-house by the first lay possessor of the monastery. This consists of a long range of two stories, not very lofty, with a highly pitched and tiled roof. Along the whole front runs an elegant cloister, 100 feet in extent, composed of a series of narrow arches in couples, with trefoil heads, and strengthened at frequent intervals with slender flanking buttresses. The eastern front of the house is adorned with ranges of rather singular windows, which have acute triangular heads, and are arranged in couples united by very slender buttresses.—Beauties of England and Wales, vol. xiii. Shropshire; by R. Ryllance, 1811. Architectural Antiquities of Great Britain, vol. iv.; by J. Britton, F.S.A. 1814.

WENLOCK, or Winlock, a town of Vermont; 90 miles N. of Windlor.

WENLOCK, or Winlock, a town of Shropshire; 8 miles N. of Much Wenlock.

WENMAN, one of the Gallipago islands, in the Pacific Ocean.

WENNE, a river of Weftphalia, which runs into the Roer, 3 miles below Everberg.

WENNEL, a river of North Wales, which runs into the Conway, near Llanrwft.

WENNER LAKE, the largest lake of Sweden, in Weft Gothland; nearly 90 miles long, and 40 wide. This lake is lored with great plenty of fish. Twenty-four rivers empty themselves into the Wenner lake, yet none flows out of it but the large river called Gotha Elbe, by which outlet
let it discharges itself into the sea. There are several islands in this lake. In the year 1744, the diet resolved to make the passage from the Wenner Lake and the Gota Elbe to Gothenburg, and from thence to Orebro, navigable. See CANAL of Trollhalla.

WENNEBORG, a town of Sweden, in West Gotland, at the south-west extremity of Wenner lake. This town was once a fortress, but at present an open town. It is the head of all the iron rent from the province of Warmeland to Gothenburg; 15 miles E. of Uddevalla. N. lat. 58° 20'. E. long. 12° 9'.

WENOA-ETTE. See OTAKOUTAIA.

WENNE, a river of England, which rises in Northumberland, passes by Morpeth, and runs into the German sea, N. lat. 55° 13'.

WENSYSEL, a town of North Jutland, anciently the see of a bishop, removed to Aalborg; 18 miles N.W. of Aalborg.

WENT, a river of England, in the county of York, which runs into the Don.

WENTHUSEN, a town of Westphalia, in the bishopric of Hildesheim; 5 miles E. of Hildesheim.

WENTZCHEN, a river of Prussia, which forms a communication between Lake Spirid and lake Wentchen. —Also, a lake of Prussia; 20 miles S.E. of Bartenstein.

WENTSUN, a river of Norfolk, which runs into the Yare, below Norwich.

WENTWORTH, Thomas, in Biography, Earl of Strafford, was born at London in 1593, and having finished his education at St. John's college, Cambridge, travelled abroad, and continued more than a year in France. Soon after his return he was knighted, and married the eldest daughter of Francis Clifford, earl of Cumberland. By the death of his father in 1614, he became possessor of a patrimony of £2,000 a year, which was considerably increased by a provision for seven brothers and four sisters, with the title of a baronet. Upon his entrance into public life he was nominated Cutfos Rotularum of the West Riding of Yorkshire. In 1621 he was returned as a member of parliament for the county of York, and during two sessions conducted himself with circumspection and moderation. In opposition to the king's assumption of unwarrantable authority, and of his affront that the privileges of the commons were enjoyed merely by his permission, Wentworth urged the house explicitly to declare that these privileges were their right by inheritance. In 1622 he lost his wife, and in 1625 contracted a second marriage with a daughter of Holles, earl of Clare, a young lady distinguished for beauty and accomplishments; and in this year he was returned for his county to the first parliament of Charles I. At this time he was a zealous oppor of the arbitrary measures that marked the commencement of this unfortunate reign; but as he was deemed a person of considerable importance and influence, the minister thought proper to make efforts for conciliating his attachment and support. As he was prevented from obtaining a seat in the new parliament which was convened, by being nominated sheriff in his county, he diligently submitted to this arbitrary act, and took no part in the contention that subsisted between the court and the house of commons. Buckingham, the tenure of whose power was becoming precarious, made overtures to Wentworth, and though they parted upon the bulk terms after a conference, he received a mandate for relieving the office of Cutfos Rotularum to Sir John Sivile, whom he had succeeded on his death. This conduct on the part of the favourite was attended with some aggravating circumstances, and very much incensed him; but he still expressed sentiments of unchangeable loyalty. Nevertheless he refused to pay his contribution to the forced loan imposed without the intervention of parliament, and for his opposition to this measure he was first imprisoned in the Marshalsea, and afterwards confined to a range of two miles round the town of Dartford. When a new parliament was summoned, in 1628, this restriction terminated, and he took his seat for Yorkshire. In this session there was competition between the advocates of an arbitrary and those of a limited monarchy. Wentworth took a decided and conspicuous part with persons of the latter description, and was one of the most active promoters of the famous Petitions of Right. By the measures which he then adopted and pursued, he showed that he was worthy the purchase of the crown, nor had he virtue sufficient to withstand the temptations by which he was affluenced. These were a peacage, and future promotion to the office of president of the council of York, or court of the north. He agreed to the proposed terms; and in July 1628 was created baron Wentworth, Norham, and Overley, by a patent gratifying his vanity by recognizing his claim to an alliance with the blood-royal, through Margaret, grandmother of Henry VII. Soon after he was advanced to the dignity of a viscount, admitted to the privy-council, and on the reigns of lord Scrope nominated lord-president of the north, with enlarged jurisdiction and powers, the exercise of which afterwards exceeded or directly violated the common law, and overwhelmed the country with oppression and arbitrary dominion. From this time Wentworth may be regarded as a minister and statesman, whose influence at court was in a little while freed from control by the affilatation of Buckingham, and in a popular assembly by the dissolution of parliament. Devoted to the faithful and diligent service of the crown, he obtained the confidence and support of government; and thus elevated, he manifested a haughtiness and imperiousness of temper which augmented the unpopularity resulting from a defection of his former principles and party. Having cultivated an intimate friendship with archbishop Laud, who had succeeded Buckingham in his influence over the king's mind, he was recommended by this prelate for the direction of affairs in Ireland; the peculiar circumstances of which were thought to require the vigour and decision of Wentworth's character. Accordingly his commission as lord-deputy of Ireland was dated in 1632, though he did not remove to that country till July in the following year. The objects which he proposed in the administration of that kingdom were to render the royal authority uncontrollable, to improve the revenues, so as to render them adequate to its own expenditure, and to afford a surplus for the English treasury, and upon the whole, to derive from it every possible advantage to the monarchy. He stipulated also for the uncontrolled exercise of his own authority. Of the various measures which he pursued in his government of Ireland, our limits will not allow us to give a minute and correct detail; but for an account of these we must refer to the history of that period. His talents and industry were unquestionable, and he certainly improved the state of the country in a variety of respects; but in accomplishing some beneficial purposes he was arbitrary and tyrannical, and chargeable with severe and vindictive proceedings, which made him unpopular both there and in England; and which probably induced the king to mortify him by refusing his request of an earldom. In 1636 he visited the English court, and made a speech before the king and the committee for Irish affairs, in which he gave a minute detail of his various measures by which he had promoted the good of that kingdom and the interest of his majesty, artfully apologizing at the same time for the infirmities of
his temper. As a farther evidence of his merits with the court, he took notice of his zeal in supporting the imposition of ship-money in the exercise of his office as president of the council of York; and thus he prepared the way for renewing his petition for an earldom, which, notwithstanding his earnings to obtain it, was again refused. Thus mortified, he resumed his government with ample powers, and pursued measures similar to those which had given him great offence. His indefatigable application to business, and the irritation occasioned by the complaints and clamours of those who had reason to be dissatisfied with his conduct, subjected him to some severe paroxysms of the gout. In 1637, he advised the King not to engage in a war with Spain, and he thus incurred the ill-will of the queen, who wished for it, as favourable to the interest of France. In the court contenter between England and Scotland, Wentworth was both an adviser and actor. After the failure of the king’s first expedition against Scotland, he went for the lord-deputy of Ireland, who arrived in November 1639. He advised the immediate renewal of hostilities, and the summoning of a parliament to provide supplies; and in order to secure his continued attachment and affability, he obtained the earldom which he had once and again fought for in vain. In January 1640, he was created earl of Strafford, decorated with the garter, and his style of lord-deputy of Ireland was changed into that of lord lieutenant, which had been dormant from the time of the earl of Essex. Upon his return to Ireland he obtained four subsidies, and levied 8000 men for reinforcing the royal army. Afterwards the office of commander-in-chief devolved upon him; but though the Scots prevailed, and the northern counties were surrendered to the enemy, Strafford still recommended strong and arbitrary measures. His credit at court, however, was now declining, and the king was obliged by his necessities to call a parliament, which proved eventually to be the “long parliament.” Strafford, perceiving his own perilous situation, requested leave to retire to his government; but the king refused to comply, and encouraged him by a solemn promise that “not a hair of his head should be touched by the parliament.” The sequel showed that Strafford’s apprehensions were well-founded; for on November the 18th, 1640, Pym, in the name of the commons of England, appeared with the charge of high treason at the bar of the house of lords; and Strafford was sequestered from parliament and imprisoned. The fallen minister was now become the object of acculsion in the three kingdoms; but the detestation and hatred of Ireland most deeply affected him. The articles of accusation against him were at first nine, but in the course of three months they were multiplied into twenty-eight. The principal object of his accusers was to fix upon him the charge of “having attempted to subvert the fundamental laws of the country.” Against this charge he defended himself with wonderful self-possession and powers of reafoning. It became necessary, therefore, to change the original impeachment into the arbitrary mode of proceeding by a bill of attainder, in pursuance which process it was only necessary to pass an enactment of his having been guilty of high treason, and having incurred its punishment. The bill passed the house with no more than fifty-nine dissentient voices; but among these were those of some of the firmest friends of the legal liberty of their country, who thought the principles of justice shamefully violated; and in the house of lords the bill was carried more by intimidation than conviction. Hopes were still entertained from the king’s promise, and his attachment to a faithful servant. But firmness was not one of the king’s distinguishing virtues. His interference to stop the progress of the bill in the house of lords had failed; and he even recurred to the plea of conscientious scruples. But his counsellors urged the danger of refuting the torrent of popular fury; the prelates, Juxon excepted, acted the part of caufults; and Strafford himself terminated the struggle by a letter, in which he persuaded the king for his own safety to ratify the bill, thus concluding it, “my content shall more acquit you to God than all the world can do besides. To a willing man there is no injury.” Love of life, however, seems to have induced him to have placed confidence in the king’s promises: for when secretary Carleton informed him of his majesty’s final compliance with his solicitations, he lifted up his eyes to heaven, and with his hand on his heart, exclaimed, “Put not your trust in princes, nor in the sons of men; for in them there is no salvation!” Strafford, between his condemnation and execution, employed himself in administering consolation and advice to his disfressed family, and making interest for their protection. On the final day, as he was quitting the tower, he looked up to the windows of Lord’s apartment, and obtained a view of him, received his fervent blessing, which he returned with “farewell my lord! God protect your innocence!” At the scaffold he made an addres to the people, expressing entire resignation to his fate, and asserting the good intention of his actions, however they might have been misrepresented; and then, taking leave of his accompanying friends, with a pathetic recollection of his widowed wife and orphan children, he calmly laid his head on the block, and, giving a signal, received the fiddle stroke that deprived him of life. He fell in the forty-ninth year of his age, lamented by some, admired perhaps by more, and leaving a memorable, though not a spotless name. The parliament, not long after his death, mitigated the sentence as far as it affected his children; and in the succeeding reign his attainder was reversed, and his heir was restored to his estate and honours.” Lord Strafford was thrice married, and left an only son and several daughters. Biog. Brit. Whitlock’s Mem. The Histories of the Period.

WENTWORTH, in Geography, a township in England, in the West Riding of Yorkshire, with about 1000 inhabitants; near it is Wentworth-Howe, a seat of Earl Fitzwilliam; 5 miles N.W. of Rotherham.—Also, a township of New Hampshire, in the county of Grafton, containing 645 inhabitants; 3 miles S.E. of Oxford.

WENTZBURG, a town of the duchy of Warwick; 40 miles E. of Gnefna.

WEOBLEY, an ancient borough and market-town in the hundred of Stretford, and county of Hereford, England, is situated 11 miles N.W. by N. from the city of Hereford, and 141 miles N.W. by W. from London. Anciently it formed part of the barony of the Lacies, from whom, by a female, it was conveyed in marriage to the Verdonos, who, by that alliance, were for some time hereditary constables of Ireland. It afterwards passed through various families to the Devereux, earls of Essex, and formed their principal lordship. On the south side of the town stood an old castle, which was taken from the emprors Maud by king Stephen. Leland mentions it as “a goodly and fine building, but somewhat in decay.” Weobly sent members to all the seven parliaments of Edward I.; the privilege was afterwards discontinued till the year 1649, when it was restored by order of the house of commons. The right of voting is possessed by the owners of the ancient burgage houses, resident at the time of election, or by the inhabitants of such houses who have been resident forty days. The number of voters is about forty-five: the returning officers are the constables, in whom the government of the town is vested. The church is spacious, and
and contains some ancient monumental chapels, in which
some of the Verdon family appear to have been interred.
The population of the parish, as returned under the act of
1811, amounted to 626; the number of houses to 160.
A small weekly market is held on Thursdays; and here are
two annual fairs.—Beauties of England and Wales, vol. vi.
Herefordshire, by J. Britton and E. W. Brayley, 1805.

WEREFER, JOHN-JAMES, in Biography, an eminent
physician, was born in 1620 at Schaffhausen, educated at
Stuttgart and Bâlœ, and after visits to several universities
in Italy, took the degree of doctor at Bâlœ, and settled in
his native place. His reputation was extensive in Switzerland
and Germany, and he attained, by his dissections and
experiments, a high rank among those who have contributed
to improve medical science. In 1658 he published a celebra-
ted work, entitled "Observationes Anatomicæ ex Cadav-
eribus corum quoque sui sui Apoplexia, cum Exercitatione
de ejus loco aucto," 8vo., often reprinted, and in some
editions with the title "Historia Apoplecticarum." In his
"De dubiis Anatomicis Epitola," 1664, 8vo., he affirms
the entire glanulâr structure of the liver, prior to Malpighi.
Another valuable work is entitled "Cicuta Aquatice Historia
et Noxæ," 1679, 4to.

His constitution was injured by an attendance at an advanced
age on the duke of Wurtzburg, and the Imperial
army under his command; and he was carried off by a dropy
in 1695. His papers were published by two of his grandsons,
in a work entitled "Observationes Medico-Practicae de afeeteæ
Capitis internis et externis," 1727, 4to. To the
Ephemerides Naturæ Curioforum, of which society he was a
member, he communicated several valuable papers. Haller,
Eloy.

WEPOLON, in Zoology, the Ceylonee name of an East
Indian serpent, of a very long and slender body, and in some
derogling a piece of cane.

WERAY, in Geography, a river of Wales, which runs
into the Irish sea, 7 miles S. of Aberystwith.

WERBEN, a town of Brandenburg, in the Old Mark,
at the confluence of the Havel and the Elbe. This town
was built by Henry the Fowler, on the ruins of the ancient Cat-
tellum Varì: 33 miles N.N.W. of Brandenburg. N. lat.
52° 53'. E. long. 20° 44'.—Alfo, a town of Pomerania;
9 miles S.S.W. of Stargard.

WERBERG, a town of Weptphalia, in the bithropic
of Fulda; 12 miles S.S.E. of Fulda.

WERBA, a town of Rafland Palatine, in the palmimate of
Braclaw: 36 miles S. of Braclaw.

WED, a town of Carinthia, on the lake to which it
gives name; 8 miles W. of Clagenfurt.

WERDA, a town of Saxony, in the Vogzland; 6 miles
N.E. of Oelnitz.

WERDAU, a town of Saxony, in the circle of Erzge-
birg; 6 miles W. of Zwickau.

WERDEL, St., a town of France, in the department of
the Soore; 40 miles S.E. of Treves. N. lat. 49° 30'.
E. long. 7° 11'.

WERDEN, a town of Germany, in the county of
Mark, on the Roer; 11 miles N.E. of Duffeldorf. N. lat.
51° 18'. E. long. 6° 55'.

WERDENA, a town of Prufian Lithuania; 18 miles
N.N.W. of Stitlöt.

WERDENBERG, a town of Switzerland, and capital of
a bailiwick, in the canton of Glarus, which was formerly
governed by counts of its own, who were at one time very
powerful. In the year 1485, it was purchased by the can-
non of Lucerne; and, after changing owners, in the years
1493 and 1498, was purchased by the canton of Glarus, in
the year 1519, and has remained ever since annexed to that
canton, though the inhabitants have several times been
murious and revolted. The town is fortified; 11 miles S.S.E.
of Appenzell.

WERDENFELS, a town and ecclesi of Bavaria, which
gives name to a county in the bishropic of Freyberg; 20
miles S. of Weilhaim.

WERDER, a town of Brandenburg, in the Middle
Mark, on an island formed by the Havel; 4 miles W. of
Potzdam.—Alfo, a district of Pomerania, between the two
branches of the Vistula, about 20 miles long, and 12 in its
mean breadth.

WERDING, a town of Austria; 4 miles N.N.W. of
Schwamnaafadt.

WERDT, or WERT. See Weert.

WERE, or Wear, a river of England, which rises in
Northumberland, crosses the county of Durham, and runs
into the sea at Sunderland; anciently called "Vedra."

WERE, a river of England, which rises near Warminster,
in Wiltshire, and runs into the Avon, near Trowbridge.

WERE, See Weir.

WERE, Wera, in our old Law-Books, signifies as much
as anmatio capitis, or pretium hominis; that is, so much as
was anciently paid for killing a man.

When such crimes were punished with pecuniary mulcts,
not death, the price was set on every man's head, according
to his condition and quality. Were fum, id est, pretium
fune redempfionis, his ranmon.

WERELADA, among our Saxon ancestors, the deny-
ing of a homicide on oath, in order to be quit of the fine,
or forfeiture, called uere.

Where a man was slain, the price at which he was valued
was to be paid to the king, and his relations: for, in the
time of the Saxons, the killing of a man was not punished
by death, but by a pecuniary mulct, called vere.

If the party denied the fact, he was to purge himself,
by the oaths of several persons, according to his degree
and quality. If the guilt amounted to four pounds, he was to
have eighteen jurors on his father's side, and four on his
mother's: if to twenty-four pounds, he was to have fifty
jurors: and this was called, werelada. Homicidium uera
folnatur, aut werelada negatur.

WEREGILD, Werregild, in our Ancient Cylioms, the
price of a man's head: pretium seu valor hominis occis, homi-
cidii pretium; which was paid partly to the king for the lots
of his subject, partly to the lord whose vassal he was, and
partly to the next of kin.

This was a custom derived to us, in common with other
northern nations, from our ancestors, the ancient Germans;
among whom, according to Tacitus (De Mor. Germ.
cap. 21.), lalur hemicidium certo armatorum ac pecuniam
umero; recipiunt satisfactionem univerfa damus.

In the same manner, by the Irish brehon law, in case of
murder, the brehon, or judge, compounded between the
murderer and the friends of the deceased, who prosecuted
him, by causing the malefactor to give unto them, or to the
child or wife of him that was slain, a recumence, which
they called eriaeh. And thus we find in our Saxon laws,
particularly those of king Athelstan, the several weregilds
for homicide, established in progressive order, from the
death of the coorl, or peafant, up to that of the king him-
self. And in the laws of king Henry I. we have an account
what other offences were then redeemable by weregild, and
what were not so. The procés called appeal had probably

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The wergild of an archbishop, and of an earl, was 15,000 thrifmas; that of a bishop, or alderman, 8,000; that of a general, or governor, 4,000; that of a priest, or thane, 2,000; that of a king, 20,000: half was to be paid to his kindred, and the other half to the public. The wergild of a ceorl was 266 thrifmas.

WEREMOUTH, Bisph's, in Geography, a parish of England, in the county of Durham, on the river Weme, with 7206 inhabitants; 12 miles N.E. of Durham. This parish is now incorporated in the town of Sunderland. See Sunderland.

WEREMOUTH, Monk's, a parish of England, in the county of Durham, at the mouth of the river Weme, opposite Sunderland, with 3555 inhabitants.

WENER, a river of Wurzburg, which runs into the Maine, 6 miles below Carolstadt.

WERFEN, a town and forte of the archbishopric of Salzburg, on the Salza, with a castle, memorable for having been the retreat of the archbishop of Salzburg, whom the duke of Bavaria had driven from his capital for having married; 15 miles N.W. of Radlafftadt.

WERGELA, or GURGELA, a town of Africa, in Biledulgerid; 300 miles S. of Algiers. N. lat. 31° 45'.

E. long. 4° 10'.

WERNAIMA, a town on the south coast of the island of Crete. S. lat. 3° 15'. E. long. 30° 18'.

WERING, or WORINGEN, a town of France, in the department of the Roer; 2 miles S. of Zons.

WERK. See Wark.

WERL, a town of the duchy of Welfphalia; 13 miles W.S.W. of Lippstadt. N. lat. 51° 33'. E. long. 7° 58'.

WERM, or VRM, a river of France, which runs into the Roer, near Welfenfandt.

WERMSDORF, a town of Saxony, in the circle of Leipſt; 36 miles N.W. of Dresden.—Alfo, a town of Bavaria, in the principality of Alchfatt; 4 miles N. of Alchfatt.

WERNBERG, a town of Bavaria; 3 miles N. of Preimift.

WERNBURG, a town of Saxony, in the circle of Neuflaft; 3 miles N.E. of Rahnis.

WERN, a town of Germany, in the bishopric of Munift; 19 miles S. of Munift. N. lat. 51° 38'. E. long. 7° 48'.

WERNEX, a town of the duchy of Wurzburg, on the Weren; 3 miles S.W. of Schweinfurt.

WERNER, Abraham Gottlob, in Biography, a celebrated mineralogist, and professor of mineralogy at Freyburg, in Saxony, was born on the 25th of September 1750. His father was inspector of an iron-work in Upper Lufatia, and at an early period intended to educate his fon for the fame employment. The fon fent rudiments of his education were received at a school at Bunfleur. He was afterwards sent to the Mineralogical Academy at Freyburg, and from thence to the university of Leipſt, where he applied himself to the study of natural history and jurisprudence; but the former he found more attractive, and it was here that he employed himself in defining the external characters of minerals, for which he was rewarded by nature with a fingular quicknefs of perception. At this place, he published, in 1774, his work on the external characters of minerals, which was considered as the basis of his ory⁵clogenetic or mineralogical fytem. (See Systems of Mineralogy.) It has been translated into various languages, but Werner could never be persuaded to publish a new and enlarged edition. "In this work," says professor Jamefon, "he gave the firſt example of the true method of defcribing mineral ſpecies. In these defcriptions, all the characters prefented by the ſpecies ſuie are detailed with a certain degree of minuſterness, and in a determinate order; fo that we have a complete picture of it, and are furnished with characters that diftinguith it from all known ſpecies, and from every mineral that may hereafter be discovered." It cannot be denied, that previous to this time, the defcriptive language of mineralogy had been much too indefinite to convey accurate information, or to enable mineralogists in dittant countries to underſ tand each other. Soon after this publication, Werner was invited to have the care of the cabinet of natural history at Freyburg, and to read lectures on mineralogy.

This situation, was well suited to the peculiarities of the man, in which he was engaged, offered abundant materials for the exercise of his talent for observation and definition. In 1780 he published the firſt part of a translation of Cronfled's Mineralogy. In his annotations on this work, he gave the firſt leſsion of his mineralogical fytem, and published many defcriptions in conformity with the methods propofed in his treatize on external characters. In this fytem, we find earthy minerals divided into four genera, fiddle, diculous, argillaceous, talcaceous, and calcareous; and thefe divided into ſpecies, sub-ſpecies, and kinds.

In 1791 he published a catalogue of the great mineral collection of Paſt Von Obafte, captain-general of the Saxon mines. In this work, he gave a tabular view of the whole mineralogical fytem, in which the arrangement of genus, ſpecies, sub-ſpecies, and kinds, is continued; feveral additions are made to the external characters, and the arrangement of the ſpecies is in fome infances changed, owing to more extended obſervations. Werner, besides his lectures on mineralogy, also delivered lectures on the art of mining, which he is laid to have rendered extremely intelligible by his fimplification of the machinery, and by drawings and figures. His fytem of geognosy, or geology, was delivered in his lectures, but never published by himself. (For fome account of this fytem, see Geology, and Systems of Geology.) "In leeting," fays a writer in the Literary Gazette of Leipſt, "he used to abandon himſelf (as he was accustomed to fay) to his mineralogical name, and when his spirit hovered over the waters and the firata, he often became animated with lofty enfuafion." He caufed his lectures to be written out by his approved scholars, and by reviving them himself made them his own in manuscript. Many parts of thefe lectures have been published in different countries by his pupils. Werner also published some mineralogical papers in the Miner's Journal; and in 1791 appeared her new theory of the formation of metallic veins. This work was translated into French by Daubiffon, and into English in 1809.

Werner was appointed counsellor of the mines in Saxony in 1792, and had a great thare in the direction of the Mineralogical Academy, and in the administration for public works.

The cabinet of minerals collected by Werner was unrivalled for its completeness and arrangement, containing 100,000 ſpecimens. This he fold for 40,000 crowns, referring the interest of 35,000 as an annuity to himself and his fifier, who had no children; and at her death, to be paid annually to the Mineralogical Academy of Freyburg.

This illufrious mineralogist died August 1817, greatly regretted by all those who were personally acquainted with him, to whom he was endeared by the ſimplicity of his manners,
manner, the cheerfulness and benevolence of his dispositions, his integrity and disinterested devotion to science. Werner was never married. His favourite pursuit next to mineralogy appears to have been the study of antiquities, one branch of it, the numismatist of the ancients, had, during the last eight years of his life, engaged much of his attention; and he had formed a collection of 6000 Greek and Roman coins, which enabled him to make researches into the different mixtures of the metals and the arts of adulteration; and to make the subject more clear, he arranged entire series of false coins. He was also attached to the study of medicine, and had made a handsome table of diseases from infancy to old age; and among his peculiarities may be mentioned his desire of offering medical advice to his friends, and his habit of judging of his own situation, which he often thought precarious. He was greatly averse to the use of vinegar and milk, but a determined beef-eater; in other respects he lived temperately, drank but little wine, and was anxiously careful about warm-clothing and rooms, a caution not well suited to the habits of a geologist. Werner had travelled little from his own country; his visit to Paris appears to have been the only distant excursion he ever made from Saxony.

Werner may justly be said to have contributed more to extend and improve the practical knowledge of mineralogy, than any one who had preceded him. His method of observing and describing the external appearances of minerals, has been introduced by his pupils, with some modifications, into various parts of the world, and has given a new and more definite form to the science. It has indeed been objected to the method of Werner, that conflicting principally in the classification of minerals according to their external characters; and in the description and arrangement of these characters, it may be regarded rather as an empiric art, than a science. But in the mineral kingdom those definite characters are wanting, which serve to distinguish the genera and species in the other departments of natural history; and he who can but relieve this difficulty, and enable the fludent most easily to gain a knowledge of minerals under all these varying forms, is entitled to the highest praise. This palm may be pre-eminently given to Werner; and whoever has justly appreciated his labours will never stop to inquire, whether his method should rank among the sciences or the arts. Mr. Kirwan was the first who introduced a knowledge of the Wernerian mineralogy into this country; but for a more complete knowledge of it, we are indebted to Professor Jameson, in his System of Mineralogy, first published in 1804, and in the second edition of 1817.

As a geologist, we cannot allow to Werner the fame degree of unmixt praise. His system of geology was formed on observations made on a very limited portion of the earth's surface in his own vicinity; and he has laid down a succession of rock-formations as universally spread over the globe, because these rocks occurred in this order in a particular part of Saxony. Subsequent observations have, however, demonstrated, that even at a little distance from Freiburg, many of the supposed universal rock-formations are not to be found, and that other rocks supply their place. The reader may consult a description of the Saxon Erzgebirge by M. Bonnard, in the Journal des Mines for 1815, to convince himself of this. It is, we confess, fortunate for Mr. Werner's fame as a geologist, that no work of his on the subject has appeared, except the "New Theory of Vena." This for some time enjoyed a certain degree of celebrity from the name of the author; but the new information which it contains is very scanty, and the theory which it supports so inadequate to explain the phenomena, and so much at variance with facts, that it was in a great part abandoned by many of the warm admirers of Werner, even some years before his death. It will now scarcely meet with a supporter among those who have any practical knowledge of mineral veins. Mr. Werner contended for the aqueous formation of almost every kind of rock, even pumice-stone and obsidian he maintained were the products of water; and when he was repeatedly invited to visit the volcanic districts of Italy, and the ancient volcanoes of France, he declined an examination which might have greatly endangered his own theory. The followers of Werner as a geologist rest his fame not on his local observations, but on his attempt to generalize his observations, in order to form a theory which should explain the structure of the earth and the mode of its formation. Indeed such was their admiration, that they would not admit his system to be a theory, but considered it as an exposition of demonstrated facts.

"This great geognost," says Mr. Jameson, "after many years of the most arduous investigations, conducted with an accuracy and acuteness in which we have few examples, discovered the manner in which the crust of the earth is constructed. Having made this great discovery, he, after deep reflection, and in conformity with the strict rules of induction, drew most interesting conclusions as to the manner in which the solid mass of the earth may have been formed. It is a splendid specimen of investigation, the most perfect in its kind ever presented to the world. (Jameson's Mineralogy, first edition, vol. i. p. 22.) We believe there are few persons who will not now admit that the admiration and praise here bestowed were disproportionate to the object, whether we regard the merit of Mr. Werner's observations for accuracy as a geologist, or the conformity of his theory with existing appearances.

The method of investigation pursued by Werner in attempting to trace the rocks in a district in succession, from the lowest or fundamental rock to the uppermost stratum, and marking the limits of each rock where it terminates on the surface, was confidered by his followers as entirely his own, and was called by them the method of the Wernerian geognost. But this method had been known and practised in England long before we were acquainted with the name of Werner; indeed it is the only one which preceding geologists could practically adopt in surveying a country. On a smaller scale, it had been practised by all intelligent coal viewers; and it had been exhibited on a larger scale by Mr. Whitehurst, in the descriptions and plates which he has given in his "Theory of the Earth." Sauffure followed no system; yet wherever the order of succession was apparent, he has not failed to inform us. But the country which he investigated, (Switzerland,) presents enormous masses, frequently in much apparent confusion, the order of succession being hid by debris or by glaciers. In other instances, whole mountains composed of different rocks appear to have been formed contemporaneously. Sauffure, who had no theory of any regular order of succession to support, has simply described facts as they exist. Our own countryman, William Smith, had been long employed in tracing the limits and order of succession of the strata in the midland and eastern counties of England, before the Wernerian geognost was known either in England or Scotland.

The originality of the Wernerian geognost consisted more in the invention of a new language adapted to support a theory, than in the discovery of a new and practical method of investigation. The language is highly objectionable in many respects, as the terms are founded on the premature assumption of the relative ages and modes of formation of...
of different rocks;—facts which are far from being yet clearly ascertained.

Whatever may be the defects of the Wernerian system as given us by his scholars, and however premature many of the generalizations may have been, it was of use by directing the attention of observers in various parts to an examination of its accordance with facts. Though the different rocks which Mr. Werner has described as universal formations neither occur invariably in the order of succession which he has described, nor are universally spread over the earth's surface; yet there is a certain similarity between the geographical arrangement of distant counties when viewed on a large scale, which indicates that similar processes of formation have taken place, and nearly in the same order in remote parts of the globe; but we are far from knowing whether these processes were universal and simultaneous, or local and successive.

In the above observations, which it is our impartial duty as biographers to state, we have not the remotest wish to undervalue the real merits of this eminent mineralogist. His theoretical errors arose naturally from the infant state of geology when he commenced his labours; and his overweening attachment to opinions too hastily formed, was an infirmity which he shared in common with many eminent philosophers. His errors will pass away with time, but his more useful labours will remain a durable monument of his talents and persevering research.

WERNERITE, in Mineralogy, a mineral regarded by Werner as a subspecies of scapolite, but which has been classified by other mineralogists as a distinct species, to which they have given this name, in honour of the professor at Freyburg. The name has been applied to foliated scapolite, compact scapolite, and to a mineral which is called Bergmannite by Stevens and Jameson. (See SCAPOLITE.) Wernerite occurs massive and crystallized in octahedral prisms, with four-faceted pyramidal terminations. The structure is imperfectly lamellar, with joints on two directions, at right angles to each other. The colour is greenish-grey, with a pearly or resinous lustre, more or less shining; it is transparent. Wernerite is softer than feldspar, yielding to the knife; its specific gravity is 3.6. It melts with inconceivably, into a white enamel.

This mineral is rare; it has been found at Arendal, in Norway; in the mines of Northho and Ultrica, in Sweden; and at Campo-Longo, in Switzerland. The constituent parts are,

| Silex  | - | - | - | 40 |
| Alumine | - | - | - | 34 |
| Lime  | - | - | - | 16 |
| Oxyd of iron | - | - | - | 8 |
| Oxyd of manganese | - | - | - | 1 | 5 |

WERNERSDORF, in Geography, a town of Pomerelia, on the Nogat; 7 miles S.W. of Marienburg.

WERNINGEN, a town of Brandenburg, in the Middle Mark; 6 miles E.S.E. of Bernau.

WERNFELD, a town of Bavaria, in the bishopric of Aichstadt; 4 miles N.W. of Spalt.

WERNHAUSEN, a town of the county of Henneberg; 4 miles N. of Wafungen.

WERNGERODE, a county of Upper Saxony, bounded on the north by the principality of Halberstadt, on the east and south by the principality of Blankenburg, and on the west by the Harz forest; about twelve miles in length, and eight in breadth. One part is mountainous, and the other level. Amongst the mountains, the most distinguished of all is the Great Brocken, or Blockberg, which is one of the highest; or, according to some, the very highest mountain in all Germany. On its summit scarce any small shrubs grow, much less trees; and the snow remains frequently there till midsummer, and in some of the northern parts even yet longer. The levels are very fertile in all kinds of grain, pulse, turnips, flax, culinary herbs, and other vegetables and fruits. The mountains afford very valuable plants, with berries of various kinds, particularly crown berries, of which great quantities are preferred; game and wild fowl are plentiful. In 1807, it was annexed to the new kingdom of Welfphalia. The inhabitants are Lutherans.

WERNICHERODE, a town of Welfphalia, and capital of a county of the same name, situated on a small river, and containing three parts: "The Old Town," containing two churches, and about 340 houses, with a house belonging to the county; "The New Town," containing one church, and about 200 houses; and the suburbs, called "Nofchenrode," which contain one church, and 150 houses. On a high mountain, directly above the town, is the castle, in which the counts' family archives are kept. The principal businefs of the town consists in agriculture, brewing, distilling, and manufactures of cloth and stuffs; 12 miles S.W. of Halberstadt. N. lat. 51° 53'. E. long. 10° 52'.

WERNITZ, a river of Germany, which rises about 5 miles S. from Rotenburg, passes by Dinkelsbuhl, Wafferdruingen, Oettingen, &c. and runs into the Danube, near Donauwirt.

WERNSDORF, a town of Bohemia, in the circle of Saetz; 3 miles N.W. of Kadan.

WERNSTADT, a town of Bohemia, in the circle of Leitzendorf; 10 miles W. of Leypa.

WERO, an island near the coast of Norway. N. lat. 67° 43'. E. long. 9° 10'.

WERPE, a river of Germany, which joins the Sieg, near its source.

WERRA, a river of Germany, which rises in the principality of Coburg, passes by Eisfeld, Hildburghaufen, Meinungen, Salzungen, Vach, Bercka, Gerlungen, Creutzberg, Trefurt, Wanfried, Allendorf, &c. and joining the Fulda at Munden, forms the Wefer.

WERRA, a department of the kingdom of Welfphalia, composed of Upper Helft, with the principality of Herford; with a population of 254,000 souls. Marburg is the capital.

WERRE, a circular or district of Hindoostan, lying on the right bank of the Pudder, which separates it from Guzerat, eait of Cutch.

WERSAL, a small island near the coast of Finland, at the entrance into the gulf of Bothnia. N. lat. 65° 46'. E. long. 31° 6'.

WERSEN, a town of Germany, in the county of Tecklenburg; 8 miles N.E. of Tecklenburg.

WERSHOCK, in Meerfuration, a long measure in Ruflia; 16 wereshocks being equal to an arheen, or 28 English inches; fo that 9 arheens = 7 English yards, and 4 wereshocks = 7 Englifh inches.

WERS, or WURST. See WERST.

WERT, in Geography. See WEERT.

WERTACH, a river of Bavaria, which runs into the Lech, a little below Augsburg.

WERTENSTEIN, a town of Switzerland, in the canton of Lucerne; 6 miles W. of Lucerne.

WERTER See, a lake of the duchy of Carinthia; 2 miles W. of Clagenfurt.

WERTH, a town of the bishopric of Ratibon; 11 miles N.W. of Straubing.
WERTHA, a river of Bavaria, which runs into the Lech, near Augsburg.

WERTHEIM, a county of Germany, situated between the electorate of Mentz, and the bishopric of Wurzburg, watered by the Maine, which here receives the Tauber. The ancient counts became extinct in the year 1556. It was afterwards divided among several princes, besides several septs of the empire, Bohemia, Wurzburg, and Fulda.—Alfo, a town of Germany, and capital of a county to which it gives name, at the confluence of the Maine and Tauber. The magnificents are principally Calvinists, but the Roman Catholics and Lutherans have a church in common; 42 miles E.N.E. of Manheim. N. lat. 40° 49'. E. long. 9° 35'.—Alfo, a town of Germany; 22 miles E. of Frankfort on the Main.

WERTHER, a town of Welfphalia, in the county of Rheinfeld; 5 miles N.W. of Bielefeld.

WERTINGEN, a town of Bavaria; 14 miles N.W. of Augsburg.

Wervick, or Warwick, or Verwick, a town of France, in the department of the Lys, on the Lys; 3 miles S.W. of Menin.

WESCHNITZ, a river of France, which runs into the Rhine, opposite Worms.

WESCOLOUEN, a town of Prussia, in Natangen; 12 miles W. of Margrâbowa.

WESE, a river of France, which runs into the Ourt, a little above Chiney.

WESEL, a town of France, in the department of the Roer; transferred in January, 1808, from the duchy of Cleves, on the Rhine. This town was formerly imperial, and governed by its own laws, under the protection of the elector of Brandenburg; 17 miles E.S.E. of Cleves. N. lat. 51° 38'. E. long. 6° 38'.

WESEL, or Ober Wesel, a town of France, in the department of the Rhine and Mofelle; 20 miles S. of Coblentz.

WESEL BAY, a bay on the south coast of the island of Java. S. lat. 8° 21'. E. long. 113° 42'.

WESELICH, or Weisling, a town of France, in the department of the Roer; 7 miles S.S.E. of Cologn.

WESEN, a town of Switzerland, in the county of Gaffer; 7 miles S. of Utzach.—Alfo, a town of Holland, in the department of Guelderland; 4 miles S. of Hattem.

WESENBERG, a town of the duchy of Mecklenburg; 42 miles N. of Spandau.

WESENSTEIN, a town of Saxony; 8 miles S.S.E. of Dresden.

WESEP, a town of Holland, on the Vecht; well fortified towards the east. The great business of the inhabitants is to carry fresh water from hence out of the Vecht to Amsterdam, for brewing and other uses, for which traffic they have a particular kind of barges; 4 miles S.E. of Amsterdam.

WESER, a river of Germany, formed by the union of the Werra and Fulda, which falls by Hameln, Rinteln, Minden, Nienburg, Hoya, Bremen, &c. and runs into the German sea, about N. lat. 50° 48'. E. long. 8°.

Wesen, a department of the new kingdom of Welfphalia, composed of the bishopric of Oldenburg, and part of the county of Schaumburg; the number of inhabitants is 33,400. Oldenburg is the capital.

WESLEY, John, in Biography, one of the principal founders of Methodism, was the fon of a clergyman, who, educated under a father who was ejected for nonconformity, became a zealous high-churchman, and composèd the speech delivered by Sacheverel before the house of lords. John was born at Epworth, in Lincolnshire, of which his father was rector, in June 1703. Educated under pious parents, he was religiously disposed from his youth. From the Charter-house, where he received his school-education, he was removed to Christ-church college, Oxford; and after taking his first degree, he was elected, in 1724, fellow of Lincoln college, and, in 1726, proceeded to the degree of M.A. At this time he was esteemed a good classical scholar, and particularly conversant with dialectics. He was also a poet of no mean talents. Soon after his election to a fellowship, he became Greek lecturer and moderator of the claffes, and undertook the instruction of pupils. In 1725 he was ordained by bishop Potter. During some years of his residence at Oxford, he was much esteemed on account of his own character and conduct, and for his attention to discipline and good morals. Upon the perusal of some devotional books, and more especially Law's "Serious Call," he became different as to his own religious fflate, and determined to pay stricter regard to what he conceived to be the essentials of a holy life. In 1729 he associated with a select number of collegians, who met and read together, first the classics on week-days, and on Sundays only divinity; but afterwards their meetings became exclusively religious. They visited the prisons and fick poor, conversed together on the state of their minds, observed the ancient farts of the church, and communicated every week. This society, which consisted of fifteen members, attracted notice on account of the strictness of their manners and deportment; and became the objects of ridicule to some young men in the university, who denominated them Sacramentarians, the Godly club, and Methodists. (See the article.) Some of the seniors of the colleges were alarmed by an introduction of fanaticism; and others encouraged them to proceed, and they received the approbation of the bishop of Oxford. Welley, after his ordination, settled as anfilit to his father at Epworth, who being defirous of retaining this church preferment in his family, wished him to seek interest for obtaining it; but his attachment to Oxford, and to the society which had been there formed, prevailed over every other consideration. In process of time he formed a purpose of going to Georgia, as a missionary; and accordingly he embarked for this province in the year 1735. The prospect of success in this mission seemed at first to be favourable; but several circumstances occurred which changed his views, and induced him to leave Georgia, after a residence of one year and nine months. These circumstances, as some persons have related them, reflect no great honour on We1sey's disposition and character. It appears, however, upon the whole, more especially when we consider Whitefield's successes in the same part of the world, that he was less qualified for a missionary than his fellowlabourer. After his return to England, he felt dissatisfied with his own state, and entertained suspicions of the reality of his own conversion, though he had undertaken to convert others. Prepared for a sudden conversion, it actually happened at a place and time, and in a manner, which he has recorded. According to his own account, this memorable event is referred to the 24th day of May, in the year 1738, at a quarter before nine in the evening, when some person at a society in Aldergate-street was reading Luther's preface to the epistle to the Romans. "He felt his heart strangely warmed. He felt that he trusted in Christ alone for salvation; and an assurance was given to him, that Christ had taken away his sins, and faved him from the law of sin and death." These feelings of assurance, however, were blended with occasional misgivings; and it seems that, in his cafe, enthusiasm could not instantaneously overpower his philosophical reallonings. His cafe is far from being singular in the history of persons of the same description. About this time
time he took a journey to Germany, in order to derive a further confirmation of his faith from intercourse with congenial spirits at the head-quarters of the Moravians, at Harnhuth. (See Unitas Fratrum.) After his return to England, in September 1738, he entered on his course of labours; and preached or exhorted, frequently three or four times a day, in prisons and other places of the metropolis, as well as in various parts of the country, where the fervour of his zeal bore a proportion to the degree of obloquy which he incurred. His exercises produced wonderful effects, and occasioned in the hearers swoonings, exclamations, convulsions, &c. which have been often the accompaniments of violent emotions. At Bristol, where he had been preceded by Whitfield, he collected large crowds of attendants in the open air. But it was now desirable that a building should be erected for the accommodation of the followers of these popular preachers. In May 1739, the first stone of such an edifice was laid at Bristol; and with this building commenced the absolute and unlimited power which Wesley exercised over his followers. "The direction of the work was first committed to eleven seoffees of his nomination; but as it became necessary for him to engage for the payment of the workmen, and to collect money for this purpose, he visited London, and upon consulting Whitfield and others, he was told, that they would do nothing in the matter, unless he would discharge the seoffees, and take the whole business into his own hands. They gave various reasons for this determination; but one," says Wesley, "was enough, viz., that such seoffees would always have it in their power to control us; and if I preached not as they liked, turn me out of the room that I had built." He, therefore, assembled the seoffees, and with their consent cancelled the instruments made before, and took the whole management into his own hands; and this precedent he ever after followed, so that all the numerous meetings of his classes of Methodists were either held in him, or in trustees who were bound to give admission into the pulpit either to him, or to such preachers as he shall appoint. Unable to associate clergymen in the prosecution of his plan, which seems to have been his first design, he determined to employ lay-preachers as itinerants to the different societies; and of these talents he formed some judgment by their performances at the meetings for prayer and mere private exhortation. Referring to himself the nomination of his preachers, his authority was extended as his societies were multiplied. For the use of these societies, he and his brother Charles drew up a set of rules for the direction of their moral and religious conduct, which are said to have been formed upon the pattern of primitive Christianity. A circumstance occurred which threatened injury to the cause of Methodism; but it eventually contributed to its extension, and to the establishment of Wesley without a rival at the head of his own body. Whitfield had imbibed a predilection for the doctrines of the Puritan divines, which were in general Calvinistic. Wesley's opinions were Arminian; so that it was impossible for these two leaders of separate tenets to unite. "The differences between them turned upon the three points, unconditional election, irresistible grace, and final perseverance, concerning which topics their notions varied so much, that Whitfield plainly told his brother reformer, that they preached two different gospels, and that he would not only refuse to give him the right hand of fellowship, but was resolved publicly to preach against him and his brother wherever he preached at all." Although they afterwards spoke of each other with esteem, yet their separation was enture and lasting.

The system of discipline formed by Wesley was admirably contrived both for gaining profelytes, and for extending and making permanent his own influence. As he did not profess to establish a new or distinct sect, he did not interfere with the regular ordination either of the establishment or of Dillenants, so that he and his preachers robbed no other ministers of their hearers; and they availed themselves of those feactions, which gave persons that were desirous of attending leasure for this purpose. That he might not be charged with drawing people away from the established church, or other societies of Christians, he did not administer the sacrament of the Lord's Supper in his own chapels, but recommended attendance for this purpose in the established church. (See Methodists.) The plan of itinerancy was a political measure in the system of Mr. Wesley, as variety serves to excite curiosity, and to increase the number of his followers. It seems also to relieve preachers and hearers, when the flock of the former is small; and it also prevents these missionaries, if they may be so called, from forming permanent connections in any place whether they are fent, and of acquiring an influence, which would be inconvenient with the supremacy of the chief. In order to maintain an union between the members of this body, and to exercise a degree of vigilant inspection with regard to their conduct, Wesley has divided each society into companies of ten or fifteen, called classes, to each of which belongs a leader, whose services it was every week to see every person of his class, and to inquire into his religious state. Many of these companies were divided into smaller parties, called bands, in which the married and single men, and the married and single women, were ranged apart, and they were directed to maintain a confidential intercourse with regard to their character and state with each other. From these bands again were formed feoffees bands, consisting of those who had attained to perfection. Of his lovers, &c. we have given an account under Methodists. Stewards were appointed to receive contributions, which the lowest members were expected to pay, however small the sums, and to superintend the temporal concerns of the societies. In order to preserve a connection between the preachers, as well as to maintain their ultimate subordination to him, Wesley found it useful to summon annually a considerable body of them, in order to consult with him, and with one another, concerning the general affairs of the societies. These assemblies were called "Conferences," and the great number of them at which Wesley had to preside was a principal means of consolidating the whole frame of the society, and maintaining his permanent authority over every part. Wesley and his first followers had many difficulties with which to contend; but their constancy and fortitude, and the apparently beneficial effects of their endeavours in reforming some of the most abandoned members of the community, enabled them ultimately to triumph over all opposition, and to pursue their labours without molestation. On account of his fanaticism and enthusiasm he has suffered ridicule and reproach; and some have even suspected his sincerity in the details which he has given of the extraordinary manifestations of light that have been communicated to him, and the no less extraordinary interpositions of Providence in his favour; alleging that he possessed a degree of understanding which could not be disputed, and, therefore, charging him with a design of deluding others, in order to serve his own purposes. But these are harsh reflections, the justice of which we cannot be induced easily to allow. About the year 1759, Wesley, who had long been the eulogist of a single life, thought proper to marry a rich widow, whose fortune he settled wholly upon herself; but this connection proved an occasion of in felicity.
to question; and he will be a memorable person as long as the fabric which he so much contributed to raise shall endure." Lives of J. Wesley, by Hampson, Coke, and Whitehead. Gen. Biog. See METHODISTS.

WESLINGBUHREN, in Geography, a town and duchy of Holstein, situated near the coast of the North sea; 53 miles N.W. of Hamburg.

WESOWKA, a town of Poland, in Volhynia; 60 miles N.N.E. of Zyтомiers.

WESSEL, John, in Biography, an eminent philosopher and divine, was born at Groningen about the year 1409, or 1419, and pursued his studies with incredible ardour both at Zwoll and at Cologne. At the latter place his orthodoxy was suspected, as he propaded difficulties which his masters could not solve. He taught philosophy for some time at Heidelberg, and after visiting several universities, went to Paris, where the disputes ran high between the Realists, Formalists, and Nominalists. He fluctuated between the opinions of these different sects. He predicted the decline of the doctrines of Thomas Aquinas, Bonaventure, and other disputants of that class; and intimated his apprehension that they would be exploded by all true Christian divines, and that the irrefragable doctors themselves would be little regarded. His reputation procured for him the esteem of Francis delle Rovere, general of the Friars Minor, whom he accompanied to the court of Basil, and with whom he returned to Paris, where he resided many years. When his patron was made pope, under the name of Sixtus IV., he paid him a visit at Rome, and being told that his holiness would grant him whatsoever he asked, he limited his request to a Hebrew and a Greek bible from the Vatican. "You shall have them," said the pontiff; "but, simple man that you are! why did not you ask a bishopric?"

"Because (answered Wessell) I do not want one," a reply on which Dr. Jortin has bestowed just applause.

This worthy person died at Groningen in 1489. On his death-bed he lamented to a friend that he had been distressed with doubts concerning the truth of the Christian religion; but at his friend's second visit, he told him with great satisfaction that his doubts were all dissipated. So extraordinary was his learning, that he was distinguished by the appellation of the "Light of the World," and such was his spirit of free enquiry, that his name is enrolled in the Protestant Catalogue of Witnesses of the Truth. Of his liberal opinions some were, "that the pope might err—that erring he ought to be refuted—that his commands are obligatory only as far as they are conformable to the word of God—and that his excommunications are lefs to be feared than the disapprobation of the lowest worthy and learned man." We need not wonder then that the monks should have committed all the manuscripts found in his study to the flames. Such as escaped conflagration were printed collectively at Groningen in 1614, and at Amsterdam in 1617. Part of them had been previously printed at Leipsic in 1522, under the title of "Farrago Rerum Theologicarum," with a preface by Martin Luther, Bayle, Molsheim. Brucker by Elnfeid.

WESSELY, in Geography, a town of Moravia, in the circle of Hradisch; 5 miles N.E. of Strzelitz.—Alfo, a town of Bohemia, in the circle of Bechin; 5 miles S. of Sobieslaw.—Alfo, a town of Moravia, in the circle of Bruns; 36 miles N.W. of Bruns.

WESSEM, or WESSEM, a town of France, in the department of the Lower Meuse; 4 miles S.S.W. of Ruremond.

WESSEN, a town of Austria; 9 miles N.W. of Efferling.

WESSNITZ. See WESSNITZ.
WEST, GILBERT, in Biography, the son of the Rev. Dr. Weft, prebendary of Winchester, and of aifter of Sir Richard Temple, afterwards lord Cobham, was born in 1706, and educated for the church at Eton and Christchurch, in Oxford; but preferring a military life, he served in the army till he received an appointment in the office of lord Townshend, secretary of state, with whom he accompanied king George I. to Hanover. In early life he entertained doubts concerning the Christian religion, which were instilled into him and his cousin Lyttelton by lord Cobham. In 1729 he was appointed a clerk-extraordinary of the privy council; and soon after, being married, he settled at Wickham in Kent. His income was not large, but it was sufficient to entertain his friends Pitt and Lyttelton, who often visited him for literary recreation at Wickham. As a poet, he was known in 1742 by a piece on a dramatic plan, intitled "The Institution of the Order of the Garter," distinguished by pure and elevated morality, and containing passages of elegant fancy and splendid diction. Weft's "Observations on the Resurrection of Christ," published in 1747, engaged the particular attention of the public, and even induced the university of Oxford to confer upon the author the degree of doctor of laws. This work was so well executed, that we may well regret his not having lived to have completed his design by another work on the evidence of the truth of the New Testament. In 1752 the circumstances of our author were improved by succeeding, when Mr. Pitt became paymaster-general, to one of the lucrative clerkships of the privy council, and his obtaining the place of treasurer to Chelsea hospital. In 1755 he lost an only son, and in the following year his life was terminated by a paralytic stroke, March 1756, at the age of fifty. "Mr. Weft was a gentleman in manners, agreeable in conversation, and lively though serious. He was regular in the performance of family devotion and in attendance on public worship, and was particularly attached to Dr. Clarke as a preacher.

The other works of Mr. Weft were, "Translations of the Odes of Pindar, with a Dissertatio on the Olympic Games;" "Translations from the Argonautica of Apollonius Rhodius, and the Tragopodagra of Lucian;" "The Aules of Travelling;" and "Education," poems in the imitation of the Flaneus and manner of Spencer; "Iphigenia in Tauris," from Euripides; and "Original Poems on Various Occasions." Several of these pieces were printed in the collections of Dodwell and Pearch, and also in three distinct volumes, 12mo. 1766; and entitle the author, fays his biographer, to a respectable rank among the minor poets. Johnson's Lives. Nichols's Lit. Anecd. Gen. Biog.

West, Occidens, Occa, in Cosmography, one of the cardinal points of the horizon; diametrically opposite to the east.

West is strictly defined, the interception of the prime vertical with the horizon, on that side in which the fun sets.

To draw a true west line, see Meridian.

West, in Astronomy, is chiefly used for the place, in or towards which the sun and stars sink under the horizon. Thus we say, the Sun, Mars, &c. are in the west.

The point in which the fun sets when in the equator, is particularly called the equinoctial west, or point of true west.

West, and Weftem, in Geography, are applied to certain countries, &c. situate towards the point of fun-setting with respect to certain others.

Thus, the empire of Rome, anciently, and of Germany, at present, is called the term of the West, or western empire, in opposition to that of Constantinople, which is called the empire of the East.
West Cape, a cape on the W. coast of Taiw-poe-nam-moo, the southernmost island of New Zealand. S. lat. 45° 54'. W. long. 195° 17'.

West Cappel, a town of Holland, in the island of Walcheren; 6 miles N.W. of Middleburg.

West Chester, a county of New York, containing 30,272 inhabitants.

The following statistical table is founded upon the census of 1810.

<table>
<thead>
<tr>
<th>Towns</th>
<th>Population</th>
<th>Sen. Electors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bedford</td>
<td>2,374</td>
<td>241</td>
</tr>
<tr>
<td>Cortlandt</td>
<td>3,054</td>
<td>182</td>
</tr>
<tr>
<td>East-Chester</td>
<td>1,039</td>
<td>96</td>
</tr>
<tr>
<td>Greenburgh</td>
<td>1,862</td>
<td>127</td>
</tr>
<tr>
<td>Harrifon</td>
<td>1,119</td>
<td>66</td>
</tr>
<tr>
<td>Mamaroneck</td>
<td>496</td>
<td>28</td>
</tr>
<tr>
<td>Mount-Pleasant</td>
<td>3,119</td>
<td>218</td>
</tr>
<tr>
<td>New-Castle</td>
<td>1,291</td>
<td>72</td>
</tr>
<tr>
<td>New-Rochelle</td>
<td>996</td>
<td>78</td>
</tr>
<tr>
<td>North-Castle</td>
<td>1,366</td>
<td>119</td>
</tr>
<tr>
<td>North-Salem</td>
<td>1,204</td>
<td>102</td>
</tr>
<tr>
<td>Pelham</td>
<td>267</td>
<td>19</td>
</tr>
<tr>
<td>Poundridge</td>
<td>1,249</td>
<td>124</td>
</tr>
<tr>
<td>Rye</td>
<td>1,278</td>
<td>85</td>
</tr>
<tr>
<td>Scarifdale</td>
<td>250</td>
<td>15</td>
</tr>
<tr>
<td>Somers</td>
<td>1,782</td>
<td>142</td>
</tr>
<tr>
<td>South-Salem</td>
<td>1,566</td>
<td>186</td>
</tr>
<tr>
<td>West-Chester</td>
<td>1,069</td>
<td>105</td>
</tr>
<tr>
<td>White Plains</td>
<td>603</td>
<td>68</td>
</tr>
<tr>
<td>Yonkers</td>
<td>1,355</td>
<td>93</td>
</tr>
<tr>
<td>York-town</td>
<td>1,942</td>
<td>142</td>
</tr>
</tbody>
</table>

It sends three members to the house of assembly. It is situated on the E. side of the Hudson, N. of New York county; bounded N. by Dutchess county, E. by the state of Connecticut, S. by Long island found and East river, W. by Haerlem river and the Hudson; or by New York county, the state of New Jersey, and the county of Rockland. Its area is about 480 square miles, or 307,200 acres, situated between 40° 47' and 41° 22' N. lat.; 3° and 32' E. long. from New York.

West Chester, a township of New York, at the S.W. extremity of Westchester county, on East river; 12 miles from New York. Its mean extent from N. to S. may be 4 miles, and from E. to W. about 5 miles, with an area of 20 square miles. It is a valuable tract of land, somewhat tony, with a large proportion of clayey loam, which, with good husbandry, may be rendered productive. Westchester village, situated at the head of the navigation on Westchester creek, contains about 25 dwellings, an episcopal church, a Friends' meeting-house, a school-house, a gristmill, and about 200 inhabitants. Adjoining to it is a bed of marble and an extensive common. In the township are several manufactories, grist-mills, three houses for worship, one for Friends, one for Episcopalians, and one for Dutch Lutherans, and six school-houses, and many elegant country-seats. For its population, &c. see the preceding article.

West Chester, a county of Pennsylvania, in the county of Chester, containing 471 inhabitants.

West Creek, a river of New Jersey, which runs into the Delaware bay, N. lat. 39° 14'. W. long. 74° 57'.

West Falmouth, a township of Pennsylvania, in the county of Chester, containing 1,157 inhabitants.

West Goshland, or Westrogothia. See Gothland.

West Harbour, a bay on the S. coast of Jamaica, formed by a peninsula, called Portland Ridge. N. lat. 17° 48'. W. long. 77°.

West Indies, in Geography and Commerce, comprehends all the islands that lie in the Caribbean sea, between North and South America; and also a few of the neighbouring settlements on the continent. (See W. Ind. The larger islands, or greater Antilles, are, Jamaica, belonging to the English, Cuba (Spanish), Porto Rico (Spanish), and St. Domingo (French and Spanish). The smaller islands, or lesser Antilles, called also the Caribbean islands, are divided into leeward and windward islands. The former are Tortola, the Saints, Barbuda, Antigua, St. Kitt's, Nevis, Montserrat, and Dominica (English), Guadeloupe and Martinique (French), St. Eustatius and Martin (Dutch), St. Thomas, Santa Cruz, and St. John (Danish), and St. Bartholomew (Swedish). The latter are, Barbadoes, St. Vincent, Grenada, and Tobago (English), Martinico and St. Lucia (French). The islands on the coast of Terra Firma are, Trinidad and Margarita (Spanish), Curacao and Bonaire (Dutch). The settlements on the continent of South America are, Demerara, Berbice, Essequibo, and Surinam (Dutch). In specifying the monies, coins, currencies, and exchanges of the West Indies, we shall avail ourselves of the arrangement of Dr. Kelly in his valuable work, and clas the islands under the five general heads of English, French, Danish, Dutch, and Spanish; premising, that though the several islands and settlements, which we have already enumerated, are subject to various political changes, they nevertheless, for the most part, retain the weights, measures, and denominations of money belonging to the European nations by which they have been colonized.

In the English islands, accounts are kept in pounds, shillings, and pence currency; the West India currency being an imaginary money, which varies considerably in its proportion to sterling, so that it is in some places reckoned at 14o, and in others 200, for 100 English, more or less. The principal coin circulating in the West Indies is the Spanish dollar, and this seems to be the standard by which the value of all other monies is regulated; and with regard to the proportion between sterling and currency, it should be observed, that although it has been declared by different authorities, yet it is chiefly regulated by the course of exchange with London. Of the English islands, the first we shall take notice of is Jamaica. The currency of this island is 10s., and its proportion to sterling is as 7 to 5; so that 1s. sterling is = 20s. currency, and 1d. currency = 1s. 3d. sterling. The price of the dollar is 6s. 8d. currency.

The gold coins current in this island, with their value in currency, appear in the following Table.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Spanifh</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doublon</td>
<td>17</td>
<td>5</td>
</tr>
<tr>
<td>Two pittole piece</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>Pittole</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Half pittole</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Portuguse</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Johannes (called joe)</td>
<td>18</td>
<td>5</td>
</tr>
<tr>
<td>Half joie</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Quarter joie</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Moidore</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Half moidore</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>English</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Guinea</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Half guinea</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Seven-shilling piece</td>
<td>19</td>
<td>0</td>
</tr>
</tbody>
</table>

R 1.2 The
The deduction for every grain of deficiency of weight is 3d. currency.

The silver coins of Jamaica are dollars, with their halves, quarters, eighths, and sixteenths, passing for 6s. 5d., 3½d., 1½d., and ½d. currency. Besides, there are bits or bitts, being Spanish reals, and passing for ½d. currency; so that 10 bits and ½d. currency make a dollar, and 1 bit is worth ½d. silver. Piftereens, or two-bit pieces, which are Spanish pecetas, pass for ½d. currency, and are worth 1½d. silver. English shillings and sixpences occasionally pass as pitfereens and bits. From the above statement it appears, that the intrinsic pair of the currency of Jamaica with respect to sterling is as follows; the calculations being made according to the mint price of gold and silver in England:

<table>
<thead>
<tr>
<th>l.</th>
<th>t.</th>
<th>d.</th>
</tr>
</thead>
<tbody>
<tr>
<td>English gold coins, 100l. /sterling</td>
<td>154</td>
<td>15 0</td>
</tr>
<tr>
<td>Spanish ditto</td>
<td>156</td>
<td>13 2</td>
</tr>
<tr>
<td>Portuguese ditto</td>
<td>155</td>
<td>0 0</td>
</tr>
<tr>
<td>Dollar</td>
<td>154</td>
<td>11 9</td>
</tr>
</tbody>
</table>

By a law of the Jamaica assembly, the exchange with England was fixed at 40 per cent.; but it has considerably varied: bills being sometimes at a premium of 20 per cent. above the legal exchange, and seldom under 10; dollars occasionally bear a premium of 3 or 4 per cent.

The currency of Barbadoes is sometimes reckoned at 135, and sometimes at 140, for 100l. /sterling; but it has never been settled by legal authority. The value of the coins has been estimated by proclamation, and according to these values the pair is above 140.

The gold coins current here, with their legal value, are shewn in the following Table.

| Spanish | Doubloon | - | - | 17 | 8 | 4 | 10 0 |
| Two-pitole piece | - | - | 8 | 16 | 2 | 5 0 |
| Piftole | - | - | 4 | 8 | 1 | 2 6 |
| Half piftole | - | - | 2 | 4 | 0 | 11 3 |
| Portugueese Johanes (called joce) | - | - | 18 | 10 | 5 | 0 0 |
| Half joce | - | - | 9 | 5 | 2 | 10 0 |
| Quarter joce | - | - | 4 | 14 | 1 | 5 0 |
| Moidore | - | - | 6 | 21 | 1 | 17 6 |
| Half moidore | - | - | 3 | 10 | 0 | 18 9 |
| Guinea | - | - | 5 | 8 | 1 | 10 0 |
| Half guinea | - | - | 2 | 16 | 0 | 15 0 |
| Seven-hilling piece | - | - | 1 | 19 | 0 | 10 0 |

N.B.—The deduction for light coin is 2½d. currency for every grain of deficiency.

The current silver coins are dollars, with halves, quarters, eighths, and sixteenths, passing for 6s. 3d., 3½d., 1½d., and ½d. currency. Also bits, which are Spanish reals, and which pass for ½d. currency; thus, 10 bits make 1 dollar, and 1 bit is worth ½d. silver. Piftereens, or two-bit pieces, which are Spanish pecetas, pass for ½d. currency. There are also French bits, called crimbal, or ile du vent bits, which pass for ½d. currency.

The Barbadoes currency compared with sterling is

<table>
<thead>
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<th>l.</th>
<th>t.</th>
<th>d.</th>
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<tbody>
<tr>
<td>English coins, 100l. /sterling</td>
<td>142</td>
<td>17 2</td>
</tr>
<tr>
<td>Spanish ditto</td>
<td>-</td>
<td>141</td>
</tr>
<tr>
<td>Portuguese ditto</td>
<td>-</td>
<td>140</td>
</tr>
<tr>
<td>Dollar ditto</td>
<td>-</td>
<td>144</td>
</tr>
</tbody>
</table>

In the English leeward islands the dollar is reckoned at 9s., and this rate is generally called the leeward currency.

A small circular piece cut out of the centre of the dollar, about one-twelfth of its value, in order to prevent its exportation, is allowed to pass for one-eighth, and is stamped by authority with the initials of the island.

The dollar, thus cut, passes for 8½d. currency; it is called the "cut dollar," by way of distinction from the whole or "round dollar." The piece taken out is sometimes called the "bit," and sometimes the "moco," which moco is, in some places, one-fourth of the dollar, and in others one-eighth. In these islands there are small copper coins, called stampe, dogs, and half dogs, valued as in the following Table.

| 1/2 Dog | make 1 Dog | - | - | 0 | 0 | 1 1 2 |
| 1/2 Dog or 4 stampe | - | - | 1 | 8 0 | 0 | 2 4 0 |
| 1/2 Bit | - | - | 1 | 0 | 0 | 9 0 |
| 12 Bits or 8 mocos | - | - | 1 | Round dollar | 0 | 9 0 |
| 5 Round dollars | - | - | 1 | Guinea | 2 | 5 0 |
| 8 Cut dollars | - | - | 1 | Joe | 3 | 6 0 |
| 16 Round dollars | - | - | 1 | Doubloon | 7 | 4 0 |

For a deficiency of weight, an allowance is made of 4½d. currency for English grain. The exchange with London is generally about 200 per cent.

In the English windward islands the currencies are nearly the same as the former, allowing for some local regulations and customs.

In the French islands accounts are kept by the French settlers in livres, sols, and deniers; and by the English (particularly in exchanges) in pounds, shillings, and pence currency; the livre and shilling being of the same value.

The currency is the same as that of the English leeward and windward islands: but the names of the coins are different; the dog being called the noir, the flambe the tempe, the bit the escalin, and the dollar the gourde.

The value of the coins appears in the following Table.

| 1/4 Dog | make 1 Dog | - | - | 0 | 0 | 1 1 2 |
| 1/4 Dog or 4 stampe | - | - | 1 | 8 0 | 0 | 2 4 0 |
| 1/4 Bit | - | - | 1 | 0 | 0 | 9 0 |
| 12 Bits or 8 mocos | - | - | 1 | Round dollar | 0 | 9 0 |
| 5 Round dollars | - | - | 1 | Guinea | 2 | 5 0 |
| 8 Cut dollars | - | - | 1 | Joe | 3 | 6 0 |
| 16 Round dollars | - | - | 1 | Doubloon | 7 | 4 0 |

The following gold coins are taken by weight.

Portugal pieces, at - - - - 22 livres per gros
Counterfeit ditto, coined in America, at 20 ditto per gros
French and Spanish coins deficient in 19l. 15s. per gross weight, at - - - - 54 livres per ditto.

English ditto at 8 livres, 8 sols per dwt., that is, 7 sols per English grain.
In the French part of St. Domingo, or Hayti, accounts are mostly kept in dollars and cents, as in the United States. The monies in circulation here are nearly the same as in the leeward islands. Dollars are valued at 4½ 6d. sterling, with halves and quarters in proportion; 1 ecusin pafe for 1 dollar, and 1 ecusin is reckoned at 9 cents. Doubloons pafe for 16 dollars; joes for 8 ditto; French crowns for 1 dollar 9 cents, and the half-crowns in proportion; French pieces of 5 francs pafe for 9 ecusins, or 8½ cents.

In the Dutch colonies of St. Eustatia, St. Martin, Curacao, accounts are kept in pieces of eight; that is, piastras current of 8 reals or shillings, each real being subdivided into 6 livres. The piastra gourde or Spanish dollar pafes for 11 reals or bits; and thus the current piastra is worth 3¾ 5d. sterling, reckoning the dollar at 4½ 6d. sterling.

The joes pafe here for 11 piastras current; the Spanish single piftole for 4½ piastras, more or less; the other Spanish and Portuguese gold coins in proportion.

In the settlements of Surinam, Berbice, Demerary, and Essequibo, accounts are kept in guilders of 20 flours; the fliver being divided by some into 8 duits, and by others into 12 pennings.

All the coins of Holland circulate here, and are mostly reckoned at 20 per cent. above their value in Dutch currency. The following is their general rate, as well as that of other monies:

<table>
<thead>
<tr>
<th>gdrs. fliv.</th>
<th>gds. fliv.</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 Dubbelty = 1 0</td>
<td>Spanish dollar = 3 0</td>
</tr>
<tr>
<td>The bit = 0 5</td>
<td>Ducatoon = 3 3</td>
</tr>
<tr>
<td>Seltehalf = 0 5½</td>
<td>Gold ducat = 6 6</td>
</tr>
<tr>
<td>Schilling = 0 6</td>
<td>Guinea = 14 10</td>
</tr>
<tr>
<td>Guider = 1 4</td>
<td>Ryder = 16 16</td>
</tr>
<tr>
<td>Dalder = 1 10</td>
<td>Joe = 22 0</td>
</tr>
<tr>
<td>Rixdollar = 3 0</td>
<td>Doubloon = 42 to 44</td>
</tr>
</tbody>
</table>

The chief circulating medium here is paper, issued by government.

In 1809 a new silver coinage was minted at the Tower of London for these colonies, consisting of pieces of 3, 2, 1, ½, and ¼ guilders. The larger piece weighs 15 dwt.; and is 1 oz. 6 dwt. worse than English standard. Its value therefore is 3½ 5d. sterling, or computing it as the dollar is now rated in the West Indies (i.e. at 4½ 6d.), its value is 33 8¾d., and the smaller pieces in proportion. They are marked on the reverse, COLONIES OF ESSEQUIBO AND DEMERARY TOKEN; and the king's head is on the obverse.

The exchange with London should be about 12 guilders for 1½ sterling, but it varies considerably above this, even to 20 guilders and upwards.

In the Danish islands accounts are kept in piastras or rixdollars current (called afio pieces of eight), subdivided into 8 schillings or bits, and each bit into 6 flivers: accounts are also kept in dollars of 100 cents, as in America. The silver coins struck for the Danish islands are quadruple, double, and single bits, and pieces of 1 and 3 flivers. The Spanish dollar pafes for 12½ bits, and each bit for 1½ flivers. The leeward currency is used in the Danish islands in the purchase or negotiation of bills on England: gold is valued at 1 dollar per dwt. or 43d. currency per English grain.

The moneys, coins, weights, and measures of the Spanish islands are the same as those in Spanish America, or Mexico; accounts being kept in pefos or dollars of 8 reals, subdivided into 16 parts, and also into 34 maravedes de Plata Mexicanos. The gold coins are doubloons of 8 escudos d'oro, worth 15 pefos; halves and quarters in proportion. The silver coins are, pefos Mexicanos, or dollars, with halves and quarters,
such as pollage, notarial expenses, and difference of exchange.

If a bill, drawn in the West Indies on any part of Great Britain, be noted for non-acceptance, the holder may oblige the drawer, by legal process, to give security in the inland for the amount, without waiting for the bill being protested for non-payment. See Kelly’s Cambium, vol. i.

WEST Iland, in Geography, one of the smaller Philippine islands, near the south coast of Mindoro. N. lat. 12° 18’. E. long. 121° 12’.—Also, a small island at the east entrance of the straits of Sunda. S. lat. 5° 21’. E. long. 106° 20’.—Also, a small island in the East Indian sea, near the south coast of Cumbava. S. lat. 8° 45’. E. long. 119° 21’. 

WES Kirk, a town of the island of Weftra, in a bay on the south coast. N. lat. 5° 9’. W. long. 2° 51’.

WEST Houghton, a township in the parish of Dean, and county of Lancaster, England, contained, in 1811, 653 houses and 3810 inhabitants.

WEST Penn, a township of Pennsylvania, in the county of Northampton, containing 947 inhabitants.

WEST Point, a town of Virginia, on the York river; 35 miles E. of Richmond. N. lat. 37° 30’. W. long. 76° 50’.

WEST Point, a town of New York, on the right bank of the Hudson river, in the county of Orange. This was a poft of great consequence, especially with respect to the communication between the northern and the middle colonies, and the poftoffice very desirable to the British general, who entered into a treaty with general Arnold the commander to betray it. The adjutant-general of the British army, major André, was employed by sir Henry Clinton as the agent on this bufinefs, and being discovered, he was executed as a spy; 42 miles N. of New York. N. lat. 41° 23’. W. long. 74’.

WEST Point, a cape at the western extremity of the island of Anticosti. N. lat. 49° 50’. W. long. 64° 30’.

WEST River, a river of Virginia, which runs into Black bay, N. lat. 36° 30’. W. long. 76° 17’.—Also, a river of Maryland, which runs into the Chefapeak, N. lat. 38° 54’. W. long. 76° 42’.—Also, a river of the province of Maine, which runs into Machias bay, N. lat. 44° 45’. W. long. 67° 19’.

WEST River, or Wantastic, a river of Vermont, which runs into the Connecticut, N. lat. 42° 50’. W. long. 73° 31’.

WEST River Mountain, a mountain of New Hampshire, near Wefit river.

WEST Town, a township of Pennsylvania, in the county of Chester, with 790 inhabitants.

WEST Wain, the west shore of Hudson’s bay.

WESTBROUGH, a town of Machaffattucks, incorporated in 1717, in the county of Worcefter, containing 1048 inhabitants; 33 miles W. of Boston.

WESTBURY, a market-town and borough in the hundred of the same name, and county of Wilts, England, is situated at the distance of 24 miles N.W. by W. from Salisbury, and 97 miles W. by S. from London. Nothing is known with certainty of its history, till the reign of Edward I., when it was constituted a corporate town by charter, under the jurisdiction of a mayor, recorder, and twelve capital burgesses. Wefitbury lends two members to parliament, and has done to regularly since the 27th year of Henry VI., who renewed its charter of incorporation, and bestowed upon it the additional privilege of being represented in the national councils. The right of election is in the holders of burbage tenures, being resident within the borough, and not receiving alms: the mayor is the returning officer. The town consists principally of one long street, running nearly in a direction north and south. According to the population return of the year 1811, it contained 351 houses, and 1790 inhabitants, who were chiefly engaged in the manufacture of woollens. A market is held weekly on Fridays; and two fairs annually, when there is usually a large supply of cattle, horses, sheep, pigs, cheese, &c. The borough and hundred of Wefitbury form only one parish: for the former, a court-leet is held by the mayor in November annually; and for the latter, one in May by the reeve of the lord of the manor, at which two high constables are appointed for securing the public peace. The only public buildings in this town which demand particular notice, are the town-hall and the church. The hall is a convenient edifice, in which the borough-courts are held: it is situated near the centre of the town, and is also appropriated in part as a wool-hall. The church is a large ancient structure of stone, with a tower in the middle. In it are several monuments in honour of persons of considerable note.

About a mile to the south of Wefitbury is the village of Leight, commonly called Wefitbury-Leight; supposed by several antiquaries to be the place designated in After by the word Engles, where king Alfred encamped on the night previous to the battle of Ethandune.

Heywood house, situated about two miles due north from Wefitbury, was built in the reign of king James I., by James, lord Ley, afterwards created earl of Marlborough. It was long possessed by the family of Chipps; but is now the property and seat of Abraham Ludlow, esq.—Beauties of England and Wales, vol. xv. Wiltshire. By J. Britton, F.S.A. 1814.

WESTBURY, a village in the hundred of Ford, and county of Salop, England, situated 8 miles W. by S. from Shrewsbury. In this village is a respectable free-school; and in the church, among other monuments, is one raised to the memory of general Severne, who inherited Wallop-hall, in this parish. About two miles S.W. of Wefitbury is Cawfe, or Caux-Cafile, which is supposed to have been erected by Roger Corbett, who held of earl Roger de Montgomery a tract of land confuting of thirty-nine manors. It is conjectured that he gave the above name to this his capital seat, in allusion to a castle in the Pays de Caux, in Normandy. As he and his son probably joined with Robert de Belesime in his rebellion, the castle is supposed to have been forfeited to Henry I., who gave it to Paris Fitz-John, from whom it was taken by the Welsh. It was restored to the original lords, and in the first of King John a weekly market was obtained for it, at the instance of Robert Corbett. Its proximity to the Welsh frontiers rendered its tenure uncertain, and we find that it was again seized by the Welsh, and restored by Henry II. In the reign of Edward III., the male line of the family becoming extinct, the castle was transferred, by marriage of a daughter of the houfe, to the Staffords, earls of Stafford; on the execution of the last of whom, Edward, duke of Buckingham, it was forfeited to the crown, but was restored to his son Edward. It was alienated in the reign of Elizabeth to Robert Harcourt, from whom it descended to lord vifcount Weymouth. The site of this castle is perhaps one of the most lofty and commanding in the whole range of the Salopian frontier. It is an inflated ridge, rising abruptly from a deep ravine on one side, and sloping towards a vall valley, bounded by the Stiperstones on the other. The keep-mount is singularly steep and towering; it must have been ascended by steps, or by a winding path, but no traces of either at present remain: part of a wall is still distinguishable;
tinguishable; the cattle itself is nearly destroyed. Parts of one of the entrance-gateways, evidently of a more recent date than the original cattle, are still to be discerned.—


**WESTBURY**, a township of Lower Canada, on the river St. Francis.

**WESTENBERG**, a town of the margravate of Anspach; 6 miles N.E. of Anspach.

**WESTENSEE**, a lake of the duchy of Holstein; 8 miles E. of Reindburg.—Also, a town of the duchy of Holstein, on the side of the lake of the same name; 8 miles S.E. of Reindburg.

**WESTERBURG**, a town of Germany, which gives name to a lordship, situated on the Wetterwald. The lords of Wetherburg succeeded the counts of Leiningen. They are counts of Leiningen and lords of Wetherburg; 16 miles W.N.W. of Weilburg.

**WESTERHAM**, a market-town in the hundred of Wetherham and Eden-bridge, lathe of Sutton, and county of Kent, England, is situated near the confines of the county towards Surrey, at the distance of 5 miles W. from Seven-Oaks, and 22 miles S.E. by S. from London. The manor was given by Edward I. to the abbey at Walthamster, for the performance of certain religious services for the repose of the soul of queen Eleanor. He also granted several privileges to the abbots, which were confirmed by Edward III., who also gave permission to hold a weekly market at Wetherham, which is still continued. After the dissolution, Henry VIII. conveyed these estates to Sir John Gretham, younger brother of Sir Thomas Gretham, the founder of the Royal Exchange: and his descendant, Sir Madamduke Gretham, fold this manor to the Warden of Squieres, a respectable feat in this parish, near the west end of the town; and John Warde, eq. is now the owner. Wetherham is rated, in the population return of 1811, to contain 27 houses, and 1,437 inhabitants. The market is now held on Wednesday; and here are two annual fairs. The church, a spacious edifice, contains a great variety of sepulchral memorials; among which is a neat monument in commemoration of major-general James Wolfe, a native of this town, who was slain before Quebec in 1759. This town also gave birth to Dr. Benjamin Hoadley, who, in the last century, was successively bishop of Bangor, Hereford, Salisbury, and Winchester.

Some singular land-slips are recorded by Halsted, as having happened at different periods in this parish. The first which is mentioned occurred in 1596, near Oakham-hill, about a mile and a half southward from the town; where about nine acres of ground continued in motion for eleven days; some parts sinking into pits, and others rising into hills. A similar occurrence took place in 1756, at Toy's-hill, about a mile and a half to the call of the town, where a field of two acres and a half underwent considerable alterations of surface, from an almost imperceptible motion.—


**WESTERHAUSEN**, a town of the bishopric of Halberstadt; 3 miles E. of Regensfeld.

**WESTERLEY**, a town of America, in Rhode island; 30 miles S.S.W. of Providence.

**WESTERLO**, a town of France, in the department of the Two Nethes; 15 miles E.N.E. of Malines.


**WESTERN Amplitude, Church, Horizon, and Ocean.**

See the several articles.
field.—Alfo, a post-town of New York, on the east side of lake George; 6 miles S. of Ticonderoga.—Alfo, a township of New York, in Richmond county, in Staten island. At its southern extremity in the S.W. is a ferry of three-quarters of a mile to Amboy, in New Jersey. It has one church near the centre, and well cultivated land. The whole population in 1810 was 1444, and the number of electors 139.—Alfo, a town of Vermont, in the county of Orleans, containing 149 inhabitants.—Alfo, a town of New Jersey, in the county of Effex, containing 2152 inhabitants; 8 miles W. of Elizabethtown.

WESTFORD, a town of Vermont, in Chittenden county, containing 866 inhabitants.—Alfo, a post-town of Massachusetts, in the county of Middlesex, containing 1330 inhabitants; 28 miles N.W. of Bolton.—Alfo, a township of New York, in Otsego county; 8 miles S.E. of Cooperstown, erected in 1808 from the N.W. part of Worces ter. Its surface is broken by hills and valleys, but has much rich mould in the valleys. The hills are adapted to grazing, and it has many tracts of meadow land. Its timber consists of maple, beech, ash, elm, firs-wood, and pine; and the whole is irrigated abundantly by springs and brooks. In 1810 the whole population consisted of 1215 persons, and the number of electors was 73, and that of taxable inhabitants 177.

WESTGATE BAY, a bay of the Thames, on the coast of Kent, W. of Margate.

WEST GREENWICH, a town of Rhode island, in the county of Kent, with 1619 inhabitants.

WESTHAM, a town of Virginia; 4 miles N.W. of Richmond.

WESTHAMPTON, a post-town of New York, in the south-east part of Long island.—Alfo, a township of Massachusetts, in the county of Hampshire, containing 793 inhabitants; 7 miles W. of Northampton.

WEST HANOVER, a township of Pennsylvania, in the county of Dauphin, containing 2461 inhabitants.

WESTHAVEN, a township of Connecticut; 3 miles W.S.W. of Newhaven.

WESTHOFEN, a town of France, in the department of Mont Tomerne; 5 miles N.N.W. of Worms.—Alfo, a town of France, in the department of the Lower Rhine; 12 miles W. of Strasburg.

WEST HOVEN, a town of Germany, in the county of Mark, at the foot of a mountain near the Roer; once the domain of the celebrated Witikind, and possessed of considerable privileges; 4 miles S.W. of Schwiert.—Alfo, a town of Vermont, in the county of Rutland, containing 679 inhabitants.

WESTING, in Navigation, the fame with departure.

WESTLAND, in Geography, a town of Ohio, in the county of Guernsey, with 250 inhabitants.

WESTMAES, a town of the island of Beyerland; 12 miles W. of Dort.

WESTMAN, or WESTMONIA, an island in the North sea, near the coast of Iceland. N. lat. 63° 20'; W. long. 20° 28'. The Westman islands suffered very much about the commencement of the seventeenth century, by the piracies of the Algerines; almost their whole population being destroyed or carried into captivity. In 1627 a large body of Algerine pirates landed on various parts of the southern coast of Iceland; and not satisfied with the booty they obtained, murdered between forty and fifty of the inhabitants, and carried off nearly four hundred prisoners of both sexes. These unfortunate captives, transported to Algiers, were exposed there to so much wretchedness, that nine years afterwards, when the King of Denmark obtained their liberty by ran-
from Weftmeath; then in its course paffing through the loughs Dervoragh and Iron, it is at length loft in that vast expanse of the Shannon, called Lough Ree, or the Royal Lake. The Brofna, rising in Lough Iron, flows from it to Lough Holye, after quitting which it paffes the town of Mullinger; it then expands into Lough Ennel, and when again contracted, flowing by the town of Kilbeggan, it enters the King's county, through which it proceeds to the Shannon. As Weftmeath is nearly central, fo its streams flow in both directions. Thofe which have been already mentioned, joining the Shannon, are mixed with the Atlantic ocean; whilft other small streams, being collected in the river Dele, take an easterm direction, and being united with the Boyne, flow to the Irish sea.

Besides Lough Shelin on the north, and Lough Ree on the western boundary, there are fix confiderable lakes in this county, and feveral small ones. Thofe are well flored with fift of various kinds, and afford a number of beautiful profts; yet it is to be regretted that fo many acres should be almost an unfuitable wafte. The fift found in thefe lakes are, perch, pike, bream, tench, trout, and very fine eels. The trout are often of ten pounds weight, and as red as a flanfon. Such is the abundance, that Mr. Young tells us that a child with packthread and a crooked pin is able to catch perch enough in an hour to support a family for a day.

This territory once belonged to Mortimer, earl of March, who married the daughter and heirefs of Lionel, duke of Clarence, third fon of Edward III. This nobleman refted much in Ireland, and was probably induced by the beauties of the fituation to build a palace at Fahatty, on the banks of Lough Derveragh, one of the finest of thefe lakes, the remains of which were faid above a century ago to retain "the lineaments and footsteps of ancient flate and magnificence." When Richard II. was deposed by Henry of Lancaster, Mortimer was the next in fuccofion to the throne, and he found it neccafary to conceal himfelf, which he did by retiring to Fahatty. By a marriage with his daughter, Richard, duke of York, fucceeded to his Irish property, and to his right of fuccofion. This nobleman refted in Ireland for fome years as lord-lieutenant, before circumftances enabled him to urge his claim to the crown, which, after a long and bloody civil war, was obtained by his fon. The attachment of the fettlers in Ireland to this family was fhewn in the reign of Henry VII., by their readily embracing the caufe of Simnel and Warbeck.

Mullinger is the flire town of Weftmeath; but Athlone is a place of more confluence. For an account of thofe, and of Kinnegad, Kilbeggan, Fore, &c. fee their repective articles in this work. Weftmeath has three representatives in the imperial parliament, two for the county, and one for the borough of Athlone.—Beaufort, Young, Collectanea, &c.

WESMINSTER, a fpacious, populous, and important city of the county of Middlefex, England, is ftituated on the north bank of the river Thames, and conftitutes the easterm extremity of the metropolis. Although in every refpect, local poftion alone excepted, independent of London, Weftminster confifts a moft eflential portion of the great metropolis of the British empire. The line of demarcation between these two cities has long indeed, by the rapid increafe of buildings, ceafed to be perceptible to general obervation; but it is not the lefs real and efficient.

The inhabitants of Weftminster, it is true, confider themfelves, in a general fenfe, as belonging to London; but for the purpofe of internal dirermination, they confine the term Weftminster to its original fignification, the feite and the environs of the prefent collegiate, formerly the abbey-church of St. Peter. Considering the city in this refticted

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Vol. XXXVIII.
reigned from 1216 to 1272, the court usually resided in Westminster. The courts of justice, which had before accompanied the king in his motions, were, by his confirmation of Magna Charta in 1225, made stationary in Westminster, where the parliament also generally met. For the convenience of attendance on the king, the courts of justice, and the parliament, for the enjoyment also of good open air, and an agreeable prospect, many of the nobles, and especially the bishops, erected palaces along the banks of the river. Pavements of inferior flatness, whose chief dependance for business and subsistence rested on those great men, were necessarily induced to fix their abode in their vicinity. In this way, a chain of dwellings, of various forts, was progressively raised between the cities of London and Westminster, and united both with the intervening village of Charing. The situations of those palaces, or mansions, as they were called, are preserved to the present day, in the succession of streets retaining their names, which communicate from the Strand on both sides, especially to the river. Thus, for instance, from Temple-bar we come to streets bearing the names of Exef, Arundel, Norfolk, Surry, Someret, Savoy, Beaumont, Cecill, Salisbury, Durham, York, &c., all calling up personages memorable in former times; but of the houses to which those names belonged, not a vestige, if we except the fragments of the palace of the Savoy, and the present Northumberland-houfe, can now be said to remain. The opposite side of the Strand being cut off from the ufe and the view of the Thames, was of course little frequented; but Exeter-chage still indicates the residence of the celebrated Cecill, lord Burleigh, whose son Thomas became earl of Exeter. Bedford and Southampton streets declare the origin of their names. As late as in the year 1553, when Edward III., was on the throne, the Strand was an open highway, crossed and cut up by water-courses from the higher grounds. It was then repaired, but not before great complaints had been made: for in the petition of the persons who lived near the palace of Westminster to Edward II., "the footway from Temple-bar to the palace" is stated to be so bad, that "the feet of horses, and rich and poor men, received constant damage, especially in the rainy season; the footway being interrupted by thickets and bushes." From Temple-bar to the palace of Savoy, the Strand feems to have been paved, or properly made about 1385, in the reign of Richard II.; but the paving went no further till the latter part of Elizabeth's reign; and in the 35th of Henry VIII. the road was stated to be "full of pits and sloughs, very perilous and noisome." In the year 1533 the Strand took the form of a street, bordered on each side with houses and gardens; among which was Covent-garden, corrupted so called from the garden of the convent, or abbey of Westminster, to which it belonged. Charing was still a detached village; St. Martin's church stood literally in the fields; and St. Giles's, also surmounted in the fields, stood in a distant hamlet in the country. Such, however, was the increase of the town in the end of Elizabeth's reign, that in 1600 St. Martin's-lane was built on both sides; and although St. Giles's church still stood detached, the great west road, now called Holborn, (properly Old-bourne, from the name of a small brook running along it,) was formed into a street all the way into London at Fleet-ditch. Covent-garden and Lincoln's-inn-fields were partially built on, as were Drury-lane and Long-acre, and principally inhabited by the gentry. The village of Charing was long before this time, or in 1202, adorned with a crofs by Edward I., being the last spot where the body of his queen refted on the way to Westminster. In 1647 it was removed, and in part employed in pavement at Whitehall; but soon after the Restoration, its place was filled, as it now is, by a statue of Charles I. on horseback. From Charing to Westminster, the bank of the Thames was occupied by the residences of royal, or other distinguished personages. First was a palace for the king of Scotland, when he came to court to attend the parliament, of which, on account of lands he held in England, he was considered a member. An ancient painting, formerly in the college of arms in London, represented Edward I. sitting in parliament, having on his right-hand Alexander III., king of Scotland; and on his left, Llewellyn, prince of Wales. The palace has long been effaced, but its site is still called Scotland-yard. To this succeeded in position the palace of Whitehall, which will be noticed in another place. The church of St. Martin stands within the limits of the old quarter, but its parish originally extended over the whole of the new quarter of Westminster; and out of it, as buildings increased, the parishes of St. Paul, Covent-garden, St. James, St. Anne, and St. George, have successively been formed. Among the various improvements lately introduced into the streets of Westminster, must be reckoned the substitution of gas-lights for oil-lamps, now much in use in shops as well as without doors. The gas, or vapour, is extracted, by a species of distillation, from coal. Purified from the inflammable aerial substances with which it is extricated from the coal, by transmifion through a body of water, the inflammable or carburetted hydrogen gas is conveyed by pipes, like water, to the places where it is wanted. By the admiffion of flame to the orifice of the pipe, the gas takes fire, producing together with a strong heat, a lively light of peculiar force and brilliancy. The coals from which, in London and Westminster, the gas is obtained with the greatest effect, are the Lancashire cannel, and the Scotch flint coals. Newcastle coal is found to be much less pure, but from its cheapness is now mostly used.

Origin and History of Westminster.—Much learning and more fancy have been employed in devising an etymology for the name of London; but the name of Westminster is too obvious to afford exercise for the skill or the ingenuity of the philologer or the antiquary. The Saxons compounding the latter name evidently refer to the church of St. Paul, in London, in the east. Stowe indeed, and some later writers, carry the reference to a monastery, not far from the Tower of London, called the East-minster. But that establishment was founded only by Edward III., in the middle of the fourteenth century, long posterior to that of Westminster, and could not therefore have given origin to the latter institution. The history of Westminster is founded on, and closely interwoven with that of the monastery of St. Peter: for to the existence and importance of the latter, the rife, progress, and prosperity of the former must be attributed.

The feite of the church and monastery of St. Peter was in early times an island, inclosed by the main channel of the Thames on the east, and by a collateral branch of that river on the west. History furnishes no information concerning the limits or the extent of this inflated tract; but by a careful examination of the ground, even under all its alterations, the course of the collateral branch may still be discovered. This branch seems to have broken off from the Thames to the east of Chelsea hospital, to have passed northward, along the natural hollow in which the water still flows to supply Chelsea water-works, and thence over a short interval, now covered with the houses of Pimlico, into the depression occupied by the canal in St. James's park, acrofs the feite of Whitehall into the Thames. In this case the island was in length from S.W.
to N.E. about one mile and three-quarters, and in breadth in the middle about half that distance. Of this spacious tract, by far the greatest portion must, in former times, have been regularly overflowed by each returning tide of the river; as it would be at the present time, were not the embankments bordering the Thames carefully preferred. The age of these mounds is unknown; but to no others than the heads of the monastery to whom the island belonged can their formation be reasonably ascribed; and to them is Westminster therefore indebted for the many advantages derived from the lands refuced from inundation. The embankments must have been constructed, and the ground within them well improved in 1386: for in that year abbott Littleton died in the manor-house of Nejfe, situated within that space. So desirable was that situation, that the duke of Lancaster, flying himself king of Cafille, had requested leave to reside in the house during the sitting of a parliament. The name of this place still survives, although absurdly corrupted into Nest-hous. In an authentic charter, dated in 785, Offa, king of Mercia, grants certain lands to the monastery of St. Peter; its situation is described to be in "Torncia in loco terribili ad Welfminster." In the writings of Sulcardus, a monk of this monastery who wrote in the eleventh century, the name is Thorne. Both these names are supposed to be formed from the Saxon Thorney, the isle of thorns and briars, expressing the wild uncultivated state of the "terrible spot" noticed by Offa. Forbidding as such a situation now would be, it bore a different aspect in ancient times; for it professed alike security from attack, and seclusion from the world. To the religious establishment on Thorney, the rife, progress, and prosperity of Welfminster are to be ascribed; but the origin and the date of that establishment itself are involved in obscurity. The probability, however, is, that it was founded by Sebert, king of the East Saxons, who died in 616. That it had in 785 acquired celebrity, is evident from the charter before-mentioned, granted by Offa. From Sebert's time the monastery seems to have been only a priory; but by Offa it was changed to an abbey, of which the abbeys arose, in the course of a few years, to the highest dignity of which their rank was insufficient. To demonstrate more fully his attachment to the patron of the abbey, St. Peter, Offa in it deposited his coronation-robes and regalia. From this circumstance, perhaps, as much as from subsequent papal authority, St. Peter's church afterwards became, and still is used for the inauguration of the English sovereigns; and to the dean, as successor of the abbey, are intrusted many of the implements and ornaments employed in that important function, which was first there performed on William the Conqueror, in 1066. After suffering severely in common with other works of the same character, by the ravages of the Danes, the abbey was restored by Edgar, who began to reign in 967, on the instigation of Dunstan, who removed thither, probably from Glen- tonbury, twelve monks of the order of St. Benedict. It is nevertheless to Edward the Confessor that the institution is principally indebted for its splendour. Sulcardus informs us that Edward had vowed to go to Rome, there to express his pious gratitude to heaven for his unexpected establishment on the English throne. The many inconveniences, however, by which the performance of this engagement must have been attended, induced him to substitute in its stead some other mode of testifying his thankfulness. He therefore undertook to rebuild the church and monastery of St. Peter in a magnificent manner, and endow them with ample revenues. Of the structure itself we only know from Matthew Paris, that "it was constructed in a new kind of arrangement, from which many perfous in erecting churches took a pattern, and strove to imitate it." Speaking of the same edifice, sir Christopher Wren refers to an account printed from an ancient manuscript. This account he translates into language proper for builders, in this way. "The principal area or nave of the church being raised high, and vaulted with square and uniform ribs, is turned circular to the east. This on each side is strongly fortified with a double vaulting of the aisles in two stories, with their pillars and arches. The crofs-building, continued to contain the choir in the middle, and the better to support the lofty tower, roof with a planer and lower vaulting; which tower then spreading with artificial winding-flairs, was continued with plain walls to its timberroof, which was wellcovered with lead." The frieking novelty in this structure was probably the introduction of an imitation of a crofs in the plan: for the earlier Saxons churches are supposed to have had no transepts. The grants of lands, and of relics, beffowed by Edward on his new foundation, were ample beyond all precedent. He likewise invested it with peculiar privileges, exempting it from all fecular services and authority, even from episcopal superintendence. But this laft exemption brought on each new abbot the trouble and expeince of a journey to Rome, to be confirmed by his holiness in perfon. Edward died on the 5th of January, 1066, having survived but a few days the splendid ceremony of the consecration of the new structure. From these privileges, afterwards extended to a considerable space connected with the abbey, may be traced in a great measure the prefeft civil constitufion of Welfminster. While Laurence was abbot in 1163, in the reign of Henry II., the power was obtained from pope Alexander III. for his using the mitre, ring, and gloves, dijtinguishing marks of episcopal dignity. But this privilege became, in the sequel, of still higher importance; for mitred abbeys came to fit in parliament as well as bishops, and to enjoy every honour to which bishops, as lords of parliament, were entitled. Laurence dying before the papal approbation of the measure was formally announced, his successor Walter was the firfl abbot of Welfminster who actually enjoyed the honours of the mitre. The reign of Henry III., of great importance in the history of England in general, is not left fo to that of Welfminster abbey in particular. In it the greater part of the edifice was rebuilt, in the lofty elegant fyle by which it is chiefly characterized; a fyle which about that time began to be adopted in ecclefiafical buildings throughout Europe. As early as 1220, although then only a youth, Henry laid the firfl fone of the chapel of the Virgin, which was afterwards superfeeded by the gorjeous structure of Henry VII.; but it was not until 1245 that he directed the church to be enlarged, and the tower, with the eastern part, to be conflrued anew. In 1260 the building was opened for divine service, and the body of Edward the Confessor was deposited in a splendid shrine erected behind the high altar.

The abbey of Welfminster is entitled to the peculiar veneration of every friend of literature, of science, and of civil and religious liberty; for within its bounds was erected the firfl apparatus for printing books employed in this island. William Caxton, a mercer of London, during a long reference on the continent as agent for the affairs of his company, and in 1464 as minister from Edward IV. to the duke of Burgundy, became acquainted with the art of printing, then very recently practised in Lower Germany. In 1471 he printed at Cologne a work which he had translated from the French into English; and returning home in the following year, he, under the patronage of the abbat of Welfminster, commenced printing in the almonry, or eleemosynary adjoining to the abbey. In March 1474 appeared his book

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on the "Game at Chefs," which may be regarded as the first production of the English press. (See Printing.) The
honour of being the first protector of printing in England
has been frequently assigned to John Hill; but this must be
erroneous; for he became a monk only in 1480, and arose to
be abbot only in 1500. To one of his predececssors, there-
fore, to Effenny, elected in 1474, or rather to Millyng,
elected in 1469, is the introduction of printing to be attri-
buted. The abbacy of Hill is however memorable on an-
other account. It was founded, on the 24th of January,
1502-3, the celebrated chapel of Henry VII. Having
obtained the crown as heir to Henry VI., he resolved to
erect a tumphant monument for his remains, in the expecta-
tion of his canonization. The first part of the project
was carried into effect, but the court of Rome requiring a
greater sum for compliance with its solicitation than the
prudent Henry of Richmond cared to bestow, the last part
of the project was relinquished. Westminster-abbey was
now on the eve of great alterations. The schemes of
Henry VIII. began to be put in practice. On the 16th of
January, 1539-40, a surrender of the whole establishment
was executed by abbot Benfon of Bolton, and twenty-four
of the monks. The annual revenue is estimated to have then
been nearly 4000l.; a sum of great real value, when the
pound of beef was regulated at one halfpenny, and that of
veal and mutton at three farthings.

Prior to the dissolution of the monasteries, Henry had
resolved to convert some of them into episcopal sees, to be
endowed with a portion of the lands or the revenues which
that dissolution would place at his disposal. Of the pro-
exed fees, Westminster was to be one; and on the 17th of
December, 1540, the abbey-church was, by letters patent,
constituted a cathedral, with a bishop, a dean, twelve pre-
bendaries, and other inferior officers. The new bishop was
Thomas Thirlby, then dean of the chapel-royal. The late
abbot Benfon was, for his ready compliance with Henry's
wishes, in the change of the abbey, appointed dean of the
new cathedral; certain monks became prebendaries, minor
canons, and students in the university; the others were di-
mified with penions, decreasing from ten pounds down to
five marks. The abbatial mansion was converted into a
palace for the bishop, whose annual revenue is variously
estimated from six hundred to eight hundred pounds. The
diocese included the whole county of Middlesex, with the
exception of Fulham, the rural residence of the bishops of
London. The endowment of the dean and chapter was not
completed till the 5th of August 1542, when lands, in var-
ious parts of the kingdom, were assigned, of the yearly
value of 2591l., out of which, however, the sum of 400l.
was to be paid for the salaries of five professors of divinity,
law, phyfic, Hebrew, and Greek, in each of the univer-
sities. A further sum of 160l. 3s. 4d. was to support 20
students in the universities; and two masters, with 40 gram-
mar scholars, were to be maintained in the school of West-
minster. The new bishopric was, however, but of short
duration; for on the 29th of March 1550, bishop Thirlby
was required to surrender it to Edward VI., and it was soon
afterwards reunited to that of London. Part of the pos-
fessions of St. Peter's cathedral were appropriated to the
repairs of St. Paul's in London; whence arose the prov-
er of "robbing Peter to pay Paul." In the edit for sup-
prefling the fee of Westminster, no mention was made of
the establishment of a dean and prebendaries, &c.; it be-
came consequently a question whether they were to be con-
tinued. To remove all doubt on this head, an act passed in
parliament, declaring the church still to remain a cathedral,
with the former establishment, but within the diocese of

London. On the accession of Mary to the throne, the re-
toration of the monastery to its primitive condition was car-
rried into effect. The abbot, John Packenham, surviving
Mary, was the only ecclesiastic of his rank who sat in the
first parliament of Elizabeth in 1558; and he took the
lowest place on the bishops' bench. But on the 24th of
May 1560, the monks were again displaced, and the church
again rendered collegiate, on a basis very similar to that
which had been established by her father, Henry VIII.
The last dean of Elizabeth's appointment was the learned
Lancelot Andrews, afterwards bishop of Winchester, dean
of the chapel-royal, and a special favourite of James I.
Since the restoration by Elizabeth, if we exclude the gen-
eral disorganization of similar institutions, in consequence
of the internal disorders which commenced in the reign of
Charles I., the collegiate establishment of the abbey-church
of Westminster has undergone no material alteration.

Abbey-Church.—Such is briefly the history of the reli-
gious establishment on Thorney, to which modern West-
minster is indebted for its origin and prosperity. Of this
establishment, the church remains in a great measure entire;
the buildings appropriated for the abbey and the monks have
undergone great alterations; but their general arrangement
may still be traced, and they are still allotted for the re-
ference of the perfons attached to the service of the church
and the dependent school. For a fully detailed descrip-
tion of this celebrated church, of its architectural beauties and
defects, of the sepulchral monuments it contains, of the cer-
emonies performed within its walls, and for a recapitula-
tion of the important transactions connected with its his-
ory, recourse must be had to the various works published spe-
cially on the subject. This church is a distinguished spec-
imen of that mode of architecture, commonly but absurdly
styled Gothic, a term which, however improper, most writers
still continue to employ, though no specific style or class of
building is defined by it. Erected in the 13th century,
when buildings in this style of architecture were well un-
tderstood, and skilfully constructed, it would doubtless have
possessed, if not the spaciousness, at least the light and airy
and elegant appearance for which such structures are generally
remarkable. But by the introduction of sepulchral mon-
uments, elevated above the level of the choir, many of them
magnificent indeed in themselves, but certainly misplaced
as far as regards the internal arrangement of the building,
that attractive appearance must very early, perhaps from the
beginning, have been injured. Owing to those encroachments,
it has been necessary to bring forward the present choir
much beyond its usual fation, not only intercepting the tran-
septs, but advancing a considerable way into the nave,
or body of the church. The building consists of a nave
and two side aisles, separated by ranges of tall, slender,
clustered columns, supporting the roof raised to a great
elevation, till further increased in appearance by the narrow-
ness of the space between the columns. The length of the whole
edifice within the walls is 360 feet, the breadth of the
nave and aisles 72 feet, the length of the choir or transept 195.
The infusion of St. Edward's chapel in the choir is partic-
ularly unfavourable; for that important division of the build-
ing was from the beginning very short: nor is it easy to dis-
cover the reason of this deviation from general usage. On
entering the great western door, the whole body of the
church displays itself to view in a very striking manner.
Lofthalls, lightposts, and elegance, are its marking fea-
tures; but these features are much obscured, and distracted by
the numerous discordant monuments, which fill up the open
spaces, and cover the walls. The nave is separated from
the choir by a screen; and east of the latter is a chapel,
WESTMINSTER.

raised above the level of the pavement, appropriated to the shrine of Edward the Confessor, but also occupied by several monuments to royal and noble persons. At the east end of this is a sumptuous architectural chantry to the memory of Henry V. Still more to the east is the splendid and interesting chapel, called Henry the Seventh's, because begun by him, and founded for his mausoleum. On the north and south sides of the choir are aisles, and also some small chapels, dedicated to different saints.

From the time of Henry VII. little was done, although very requisite, to the exterior of Westminster church, till that of George II., when many parts of it were coated over with stone, and otherwise repaired at the public expense. Some time before this, the two towers at the west end were completed from designs of Sir Christopher Wren, as they now appear. In covering the outside of the church, the rich sculpture, and the statues which formerly adorned the buttresses, could not be restored. Tho parts seem now, therefore, unsuitable to the highly ornamented building to which they are attached: nor do the western towers affiliate with the style of the fabric to which they belong. The paintings in the great west window were executed in 1735: the window in the south transept was also renewed in 1765. In the interior of the church, the pillars dividing the nave from the side aisles guide the eye to the fine painted window at the extremity of the choir, which, in former times, when the altar-piece was low, must have had a fine effect in giving a lighter air to that part of the building. The altar-piece was brought hither by Anne in 1706: it had formerly belonged to Whitehall chapel. The marble columns of the Corinthian order, however elegant in themselves, but all accord with the style of the structure around them; an incongruity but too often functioned in other edifices of the same kind in England. In front of the communion-table is still to be seen, although woefully mutilated, a curious Mosaic pavement of lapis lazuli, porphyry, Jasper, Serpentine, touchstone, &c. placed there by abbots Ware in 1272, who brought it from the continent, where he procured the materials during a mission to Rome. The black and white checkered marble pavement of the choir, was the gift of the celebrated Dr. Bushy, master of the school annexed to the church. In the centre of Edward the Confessor's chapel stands the mutilated body of the shrine, containing, in a wooden case, the ashes of St. Edward; and around the sides of the chapel are ranged the monuments of several kings, queens, and princesses, from Henry III. to Elizabeth, the daughter of Henry VII.; all of which are extremely curious and interesting. In this chapel are preserved the chairs, one very ancient, the other made for the last queen Mary, in which our kings and queens are seated within the choir at their coronation. In the frame of that used by the king is the fatal stone, to the position of which the sovereignty of Scotland, or rather of the Scotch nation, was attached.

The choir of the church, in the form of a semi-octagon, was surrounded by eight chapels, now reduced to seven, by the appropriation of the central chapel to be the porch of that of Henry VII.

The crofs-aisles or transepts of the church, as well as the nave, have long been consecrated to the interment of persons in various ways distinguished in the world. The south transept has only an eastern aisle, the west being occupied by part of the cloisters. This transept, named Poets' corner, contains many interesting memorials of men whose genius and talents in science, literature, and the arts, entitle them to the honourable recollection of posterity. Of these monuments, many are highly interesting as memorials of eminent characters, and others as specimens of the sculptor's art. No small number of them, however, and those not the least sumptuous and ornate, are entitled to no regard on either account, being vaft masses of marble devoid of beauty and taste. It is, however, to be remembered, that to be numbered among the illustrious dead,' within the walls of the abbey-church of Westminster, now is and long has been purely a question of finance with the officers attached to the foundation.

Chapel of Henry VII.—In ancient cathedrals and other churches of considerable extent, it was the practice to appropriate to the peculiar service of the Virgin, the chapel situated immediately behind the high altar, and in the eastern recess of the building. Such a chapel originally belonged to the abbey-church; and on its site was some adjoining space, under the same patronage, but now best known by its own name, Henry VII. constructed his magnificent and admirable chapel. When we contemplate this most curious specimen of English architecture, and consider the expense which must have been encountered to complete it, we are utterly unable, on any rational grounds, to reconcile its erection with the acknowledged disposition and character of the founder. In perusing the history of nations, we must be struck with the frequent recurrence of this fact, that men of all degrees, particularly of the highest, have acted on the vain supposition, that by a single ostentatious act of beneficence or munificence, not unfrequently profligate, they could acquire immortal fame, and even secure the favour of heaven, however unworthy they may have performed their duty in life. Of this fact, the chapel of Henry VII. stands a memorable example; for in no one of his life and reign, did that prince give evidence of any one of those feelings from which the construction of this superb structure could be expected to proceed. Of benevolence, however, in a certain sense, no sovereign ever had a better conception than Henry. The vaft sums he exacted under this inauspicious title, far exceeded the demands for which they were required: he accordingly amassed great wealth, and at his death his treasury was enormously rich. Towards his end, Henry, sensible of a mil-spent reign, endeavoured to atone for his offences by various charitable works, by bequeathing a large sum on the college chapel in Cambridge, and in particular by founding, erecting, and endowing his chapel in Westminster. From the elegance and richness of the design, and from the skill and labour necessary to complete it, we are warranted to conclude that the most eminent artists and architects of the country were employed. The first stone of the new chapel was laid by the hands of abbot John ilip, and otherpersons of the court, in the presence of Henry, on the 24th of January 1502-3. How much of the work was executed at the king's death, on the 21st of April 1509, is unknown; but most probably the masonry must have been nearly, if not altogether, completed. Towards the finishing of the whole, Henry left, in the hands of the abbot, 500l., with provision for more if required. The superb tomb for the king is particularly described in his will; but a different plan was followed, and the work was finished by his son Henry VIII. The ground-plan of the building consists of a body nearly a square, terminated at the east end by a semicircular part, composed of five sides of an octagon. The extreme length of the whole chapel, including the porch, is 134 feet, and the corresponding breadth 82 feet 6 inches. On viewing the exterior of the building, we are struck by the apparent lightness of the work; for instead of walls, the principal weight and quantity of the whole rests on a few detached piers and lateral buttresses. This peculiar character of ancient
ancient ecclesiastical buildings, manifests great science and skill in the architects; for to raise lofty walls, and poise ponderous wide-spread roofs on piers and columns, requires the nicest geometrical accuracy. The fides are supported by five octagonal piers; those of the semicircular end are united to wedge-shaped mafles, falling to the nave, as to correspond with the pillars separating the aisles from the nave. The interlaces between the external piers are filled by windows of a peculiar plan and great delicacy of workmanship. The roof over the nave refts on perpendicular walls, supported by very slender internal pillars, and is strengthened all round by flying buttresses or semi-arches from the external piers. Within, the chapel is divided by two ranges of pillars into a nave 33 feet 6 inches in width, and side-aisles each 11 feet 3 inches wide. The internal roof is executed in fone, with pendants and numerous ribs. By the advance of the piers in the circular part, the end is formed into five small chapels or oratories; but the side-aisles in their original had no separation from the nave, except the ranges of pillars. They are now, however, unfortunately cut off by a row of stalls on each side, on the line of the pillars, and shooting up with their fretted and frittered canopies as high as the roof of the aisles. What tends to heighten the deformity of these stalls, is the number of gaudy flags of the knights of the Bath, who are interred in this chapel, fupended all around, at once concealing many beautiful parts of the architecture and sculpture, and utterly at variance with the elegance and the design of the edifice. The entrance to the chapel is by a flight of steps to a magnificent gateway, but from its situation dark in itself, and darkening the extremity of the adjoining church. The chief object within the chapel is the tomb of the founder, inclosed by a screen of gilt brafs: it is a piece of admirable workmanship, executed by Torregiano of Florence, a rival of Michael Angelo. There also, flill in opposition, lie the jealous and vindictive Elizabeth and her unfortunate victim Mary Stuart. Thus in a corner of the abbey-church, a few feet only of earth now separate the once formidable political antagonists William Pitt and Charles James Fox. The bronze figure of Margaret Tudor, mother of Henry VII., is one of the finest pieces of sculpture in the whole building. In viewing this chapel, two subjects always excite regret; the situation in which it stands, and the materials of which the exterior is constructed. Attached to the end of the abbey-church, with which its mode of construction has but a very distant relation; although in itself, if furnished with a fitable front-piece, worthy to be a separate and independent work, it now links into a mere appendage. The exterior surface of the chapel is in many parts corroded and confounded; and moff of the sculpture is now quite defaced. Some years ago parliament voted a confiderable sum of money, to be annually applied to defray the expense of new-casting the whole edifice with Bath fone, and the work has been carried on under the directions of Mr. T. Gayfere, with ferupulous attention to the form and manner of the original workmanship. Beneath the chapel is the vault prepared on the death of Caroline, queen of George II., containing the remains of several members of the present royal family. The cloister of the abbey, fufficiently ftrengthened, and containing numerous sepulchral inscriptions, communicates with the ancient chapter-houfe, which is of octagonal form, and the roof is supported by a branching central column. It was erefted, according to Matthew of Welfminster, in 1258, by Henry III. This building, which, till the time of Edward VI., served as a houfe for the commons of England, is now employed to preferve public records; amongst them, the celebrated Liber de Wintonia, as it was called by the compilers, or Domesday-book, as it was not unaptly named by thofe persons whom it regarded. This work, the moft ancient and venerable record, or iflatificable account, as we now fpeak, of which this or any other country can boast, was completed about 1086, in the end of the reign of William the Conqueror. (See Domesday-Book.) In the fame chapter-house are also preferved the recorded proceedings of the notorious star-chamber, to called from the ftar-like ornaments of the roof.

School.—The cloifor also communicates with the celebrated school of Welfminster, which was refounded by Elizabeth in 1590, with an eftabliffment for the classical instruction of forty boys. After a certain time, the scholars, if duly qualified, are flected alternately for their respective institutions, by the dean of Chrift-church, Oxford, and the master of Trinity college, Cambridge. Besides the youths on the foundation, from three to four hundred, others usually receive their education in the school, at the ex- pense of their respective parents.

Paroh Church of Welfminster.—The city and liberties are now diftributed into ten parishes. Within the city are St. Margaret's and St. John the evangelft's; within the liberties, St. Martin's, St. James's, St. George's, St. Anne's, St. Paul's, St. Clement's, St. Mark's, and the Savoy. St. Margaret's, the original church of the city, is a fimple plain ftucture. It is handsomely fupported up to accommodate the commons of the kingdom on certain folemn occasions. As the choir of the neighbouring abbey-church is allotted to the peers of parliament. One peculiar ornament of St. Margaret's church is a magnificent painted window representing the crucifixion. This very interefting picture was executed in Holland as a present for Henry VII. St. John's church, belonging to a parish formed out of St. Margaret's, furnifhes an admirable example of what imagination, unrestrained by judgment and taste, can produce. It ought however to be known, that Mr. Archer, and not Sir John Vanburgh, who has been oftener blamed than underflood, was the architect of this fabric. St. Martin's and St. George's churches are remarkable for their noble porticoes; but both are, unfortunately, not to pay abfurdly fét, that it is impoffible to have a view of them in any way fatisfactory. St. Paul's, Covent-garden, is noted for its fimplicity, and its plain, heavy, Tuscan portico. In erefting the latter at the end of the church, where it can be feen, Inigo Jones effayed a bold deviation from eftablished practice; but to change the interior diftribution of parts was perhaps beyond his power. The portico therefore stands where no entrance can be opened, for there with flands the communion-table, and the entrance is opened at the eft end, where there fould be, but is not, a portico. The church of St. Mary, like that of St. Clement, is strangely placed in the midft of the Strand, a moft public and noify freet; and instead of poifefing the fimple dignity of a Christian temple, feems rather a model contrived to fhow the skill of the architect in comprehending the greatest quantity of ornament devoid of utility, within the narrow fet bounds. But Mr. Gibbs the architect followed his instructions in adorning an edifice to be fo oftentatiously exhibited. He had besides but jufi returned from Italy, where fimilar structures abound. It is no wonder, therefore, that, in both the interior and the exterior of the New church of St. Mary, he was led to imitate the buildings he might, as a mere fudent of architectural defign, long have admired. Besides the churches and chapels of the eftabliffment, Welfminster contains places of worship for Chrifrians of all denominations, and of professions the moft contradictory, from the moft Spanifh to the moft Swedenborough, who maintains the fole
and absolute divinity, to the simple Unitarian, who afferts the pure humanity of the great founder of the Christian religion. French, Swiss, Dutch, and German Protestants, have proper places where the service is performed in their own languages. The Society of Friends or Quakers have a respectable place of assembly in St. Martin's-lane; and various chapels are open for the members of the church of Rome. In Denmark-court, in the Strand, is a well-frequented Jewish synagogue.

Civill and Political State of Westminster.—The first dwellings constructed around the monastery in Thorney, stood on the lands of the establishment, which consequently had full authority to govern the inhabitants. These were rapidly increased in numbers by the privilege of sanctuary granted to the abbey for offenders; but the great causes of the growth, population, and importance of Westminster, were the residence there of the kings, and the transference of all public business within its precincts. Although the Strand, Whitehall, and a few other places were inhabited, at the elevation of the abbacy into an episcopal see in 1540, yet the quarter only immediately enclosing the cathedral church was honoured with the title of city. The whole of this quarter was included in the original and ancient parish of St. Margaret; but in order to accommodate the increas'd number of inhabitants, especially in the southern parts, a new parish was formed out of the old in 1728, and named after St. John the evangelist. All the other quarters of the present Westminster, erected on the liberties of the abbey, are contained within the following eight parishes, arranged in the order of their establishment. St. Clement's Danes, St. Martin's in the Fields, and St. Mary's in the Strand, all of uncertain antiquity. St. John the Baptist's, in the Savoy, also ancient, St. Paul's, Covent-garden, St. James's, St. Anne's, Soho, and St. George's, Hanover-square; the last four all formed within the last 200 years. In designating Westminster in the aggregate, the city and the liberties are necessarily mentioned; but in no respect does any distinctive rank, right, or privilege exist between the inhabitants of those different quarters, who are all equally citizens and members of the same community. On the public change of religion, and the conversion of the abbey of St. Peter into a collegiate establishment of a dean and chapter in 1560, the latter were placed, as to all their civil rights and authority, in the situation poffessed by their predecessors; but the sanctuary was, with all other similar privileges, suppreffed in the 21st year of James I. The dean and chapter of St. Peter's have, therefore, continued ever since to be the supreme magistrates and administrators of the inhabitants of the city and liberties of Westminster. Since the Reformation, however, the exerçís of all civil powers has always been vested in lay persons, elected or confirmed by the dean and chapter. Of this singular and anomalous system of government, which, though applicable forever to the original, seems wholly unsuitable to the modern Westminster, the following are the principal members, as feated by an act of the year 1585:—The first is the high-steward, usually a resident nobleman of distinction (the present is the duke of Northumberland), who is elected by the chapter of St. Peter's; the dean acting as high-steward during and previously to the election. By this principal officer a deputy steward is nominated; but his appointment must be confirmed by the dean and chapter. This deputy acts as a sheriff, holding the court-leet with the other magistrates: he is always chairman of the quarter-sefions of Westminster, which are independent of those of Middlesex. Next in rank is the high-bailiff, nominated on the other hand by the dean and chapter, but confirmed by the high-steward. He is the returning officer in the election of the representatives in parliament for the city and liberties; and to him all the other bailiffs are subordinate. He summons juries, and has a right to all fines, forfeitures, and fines, within his jurisdiction: he also, on due requisition, calls together and is present in all assemblies of the electors, for the purpose of petitioning parliament or the crown, or of transacting any other public business within which they are all concerned. The high-official, chosen at a court-leet of the magistrates, has all the other offices under his superintendance. In addition to these officers, sixteen householders, styled burgesses, are chosen, with their affiliates out of the different parishes. These re semble the aldermen and common-council of London, each having a particular ward or district under his inspection; and of their number two head burgesses are chosen, who, at the court-leet, sit next to the high-bailiff. The inhabitants of Westminster form no corporation, nor do they possess such any exclusive privileges; neither do any companies of trade or profession exist within the jurisdiction. The various courts of justice belonging peculiarly to Westminster are, 1. The court of the duchy of Lancaster, a supreme court of record, held in Someret-place, for deciding by the chancellor of the duchy all matters of law or equity concerning the estates belonging to the county-palatine of Lancaster. 2. The quarter-sefions of the peace, a court of record, held by the justices of the peace at the Guildhall, near the abbey-church, for all trefpafs, &c. committed within the city and liberties. 3. The court-leet, held by the dean, or his steward, for choosing parish officers, preventing and removing nuisances, &c. 4. Courts of requits, or of confidence, as they are called, for deciding without appeal by commissioners, all pleas for debt under forty shillings. 5. Courts of petty-sefions, held every lawful day at the offices in Bowstreet, Marlborough-street, and Queen-square, for matters of police, misdemeanors, or offenses. 6. To these must be added the court of St. Martin-le-grand, in London, but belonging to Westminster. The jurisdiction of the dean and chapter of St. Peter's, widely extended as the liberties are, is not confined to their bounds. In the very heart of London, under the walls as it were of St. Paul's, is the precint, as it is termed, of St. Martin-le-grand, an integral part of Westminster, and wholly independent of London. This precint took its name from a college church founded in 1556, dedicated to St. Martin and qualified le-grand, on account of the great privilege of sanctuary conferred on it. By Henry VII. it was belowed on the abbey of St. Peter; but on the surrender to Edward VI. it was pulled down, and houses were built on the ground. Being let out to strangers not freemen of London, they claimed the privileges before enjoyed by the canons of the suppreffed institution. These claims produced many contentions which were never definitively settled; and the exemption of St. Martin's precint from the jurisdiction of London seems now to be effectually, rather than long-continued usage than by any regular or authoritative declaration of right. This small precint (a term in London signifying specifically a subdivision of a ward) consists of one short street of its own name, leading north from the east end of Newgate-street to the beginning of Aldergate-street, and a few lanes and courts on each side. In this precint persons not freemen of London, exercise their several trades or professions without control; the inhabitants also concur in the election of representatives for Westminster, in the same way with those who actually dwell within that city. A very material change is now (1818) in progress in St. Martin-le-grand. The chief office of the general post, domestic and foreign, situated in Lombard-street, in Lon-
Westminster.

London, has long ceased to be either central in position or commodious in distribution, for the prodigious business transacted in it. After many attempts, chiefly on the part of the inhabitants of the west end of the town, where many of the principal men of business reside, parliamentary function has at last been obtained for the erection of a new post-office, properly adapted, in situation and internal arrangement, to the purposes of the establishment. The situation selected is in St. Martin-le-grand; and the necessary preparations in removing houses and clearing the ground, have made considerable progress. The expense of this enterprise must be great; but the edifice may be rendered highly ornamental as well as useful to the metropolis. Mr. Kay is the architect. The jurisdiction of the dean and chapter of Westminster extends also over some places in Essex, on that account independent of the diocesan bishop of London, and even of the metropolitan of Canterbury; for while the Roman Catholic religion prevailed, the abbey was immediately under the pope. If the jurisdiction of the abbey thus extended over places remote from its bounds, it on the other hand comprehended within its bounds, a district exempt from its jurisdiction. This is what is commonly called "the liberties, or the duchy of Lancaster." The district comprehends all the south side of the Strand, from the Temple to Cecil-street, with nearly the same extent on the north side. The palace and district of the Savoy having been a part of the possessions of the house of Lancaster, which were separated from the crown by Henry IV., that part of the Strand belonging to the Savoy became a district or liberty of itself. It has a supreme court under the chancellor of the duchy of Lancaster, as already mentioned; and formerly no inhabitant of this district voted for the representatives of Westminster. But at the election in March 1795, those of the duchy-liberties who lived within the parishes of St. Mary in the Strand, and St. Martin's in the Fields, were admitted to give their suffrages. Until the dissolution of the abbey, Westminster lent no representatives to parliament; being virtually represented by the abbot, who sat with the bishops in the house of peers. In the records of the late parliament of Henry VIII. no mention appears of any summons or returns relative to Westminster, Peterborough, or any other abbey-town. The first parliament of Edward VI., therefore, is, that in which the members for Westminster began to take their place. The two representatives of the city and liberties are elected by the inhabitant householders, or those paying scot and lot, who are now estimated at about 17,000; the number being considerably increased by the enlargement before-mentioned in 1795. The elective franchise being thus widely diffused among all ranks of the inhabitants, and the popular favor being commonly in the inverse proportion of that of the court, one if not both of the representatives of Westminster may generally be expected to be decidedly hostile to the measures of the existing administration. So well is this understood by ministers, that, to have at least one member favourable to their views, they have frequently encouraged some distinguished naval commander to offer his services to the electors.

Having for many years been the ordinary residence of the sovereign, Westminster has of course contained the principal departments of every branch of legislative and executive administration. The parliament, originally ambulatory and attached to the peron of the king, was rendered flable in Westminster on the confirmation of Magna Charta by Henry III. in 1216. Long before that period, the royal palace was erected adjoining to the abbey; and as in those early times justice was often administered by the king in person, or in his presence, the various courts of judges were of course established in or near his residence. When the palace of Westminster ceased to be occupied by the monarch, and Henry VIII., in 1512, transported his court to Whitehall, the parliament and the judges still retained their original station; but the executive branches of administration, relative to financial and military affairs, accompanied the court. Hence we find those departments all established in what is still called Whitehall; although the king has long ceased to reside in that quarter, and that a very small portion of the old palace is either occupied by public offices, or even in existence. Hence also it is that all public acts of government are dated from Whitehall. From the prodigious multiplication and subdivision of all public affairs relative to justice, finance, and military and naval operations, the details of various branches have necessarily been carried on in other convenient quarters of the metropolis. Such are the Temple, Lincoln's-Inn, Guildhall, the Bank, the Cullom-house, the Excise-office, the Tower, &c.; still it is in Westminster alone that the general arrangement of the whole is continued.

Public Buildings.—Of the ancient residence of the kings of England in the vicinity of the abbey of Westminster, the name, the general position, and a few mutilated apartments, are all now remaining. According to a survey and plan of the whole buildings and vestiges of this palace, it extended along the bank of the Thames from north to south, and then turned westward near to the buildings of the abbey. Of the general arrangement, it is impossible to discover more than that the walls and foundations seem to have been all parallel to the corresponding walls of the present great hall, the only part still remaining in its original state. Composed of parts erected at different periods, no balance or symmetry of plan seems to have been regarded in their distribution.

Westminster Hall, memorable in itself as a building, as the scene of many important transactions, and for the uses to which it is applied, was erected by William Rufus, or William II., about 1067, as an appendage to the old palace, or a part of a new project. Having suffered much from accidental fires, as well as from the lapse of time, the hall, just three centuries after its construction, was completely restored by Richard II., who heightened the walls, altered the windows, adding a new roof, and built a flately gateway. The hall is a vast parallelogram, standing north and south, in length, within the walls, 249 feet, and in breadth 66 feet, not 74, as is generally stated. The walls, although massive and plain, are externally strengthened by buttresses. The roof, rising to a high pitch, is ingeniously and firmly constructed, not of Irish oak, as usually said, but of chef out brought from Normandy. This room is said to be of greater magnitude without pillars than any other known. In this hall parliaments have been held; Richard II. was deposed in it in 1399, and for many ages it has been employed in the coronation-feasts of the sovereigns. In it assembled the court for the trial of Charles I., in January 1649. It is still the place of inquiry, before the house of peers, into the conduct of persons impeached by the house of commons. In the middle of the right or west side of the hall, is an opening into the court of common pleas. The south end of the hall is occupied by wooden structures, to contain on the right-hand the court of chancery, and on the left the court of king's bench; so called because the king in ancient times actually sat, as he is at present averted, by what is styled a legal fiction, actually to sit, on the bench to administer justice. Between these two courts flairs conduct to the apartments occupied by the two houses of parliament. That employed by the peers was towards the south end of the old palace; but on account of the additional number of 32 peers enti-
tled to feats on the union with Ireland, over and above the
unexampled augmentation of the peerage in the present reign,
their meetings were transferred to what was the court of re-
quests; so called because the masters of the court, in ancient
times, received the requests or petitions of the people, and
gave their opinions on the subjects. This room, consider-
ablely larger than the former, is also within the old palace;
and is now ornamented with the celebrated tapestry, represen-
ting the discomfiture of the Spanish Armada, and fleet
and army, defined for the invasion of England in 1588.
At the upper end of the room is the throne, a highly en-
riched arm-chair; and at the lower end is an open space,
termed the bar. The commons of England, when they
formed a separate body from the peers, were, by an agree-
ment with the abbot of St. Peter's, allowed to meet in the
chapter-house already mentioned. But when, at the Re-
formation, the establishment of the collegiate chapel of St.
Stephen in the old palace was suppressed, to that place their
meetings were transferred by Edward VI. This chapel,
originally constructed by king Stephen, was rebuilt by
Edward III. in 1347. The commons, before the union
with Ireland, were accommodated within the chapel; but
their number being by that measure augmented from 558 to
658 members, it became necessary to enlarge the place of
assembly. At the eall, or upper end of the room, is the
speaker's chair; before it is the table with the clerks, and at
the bottom is the bar. The seats for the members ride one
behind another, as in a theatre. Those on the floor, on the
speaker's right-hand, are called the treasury-benches, and
occupied by the members of administration: the bench in front
is usually occupied by the leading members of the opposi-
tion. St. Stephen's chapel, highly adorned by Edward III.,
suffered greatly by its first adaptation for the commons;
but much more by the late alterations. By removing the
wainscot, a great part of the ancient decorations was dis-
closed, and a very important fact in the history of the fine
arts was, for the first time, ascertained. On the 11th of Au-
gust, 1800, was discovered a series of sculpture and painting,
the latter exhibiting portraits, scripture-faces, and other de-
corations, interesting in themselves, and peculiarly so as speci-
mens of the taste of the arts, as they existed nearly five
hundred years ago. It has been usual to ascribe to John Van
Eyck, of Bruges, in Flanders, the invention of painting in oil-colours, in 1410. This opinion has, however, of late
years, been much invalidated; by the discovery in St. Ste-
phen's chapel it is completely overthrown. From original
records of the expenses incurred in the construction and de-
coration of that building, it now appears that the renovation
was begun in the fourth year of Edward III., or about 1329,
and not in 1347, as stated by Stowe and others: that the
painters had not begun in 1345, but were at work in 1350,
and ceased to be mentioned in 1364: that those who painted
on glafs had begun in 1350, and finished in 1352: that the
paintings were unquestionably in oil: and that, of seventy-
five painters employed in the chapel, the whole, with the
exception perhaps of two, and they not the masters, were
natives of England. From these authentic documents it is
therefore fully ascertained, that pictures, in the usual sense of the term (not house-painting), in oil were executed in West-
minster palace in 1350, or sixty years before. Van Eyck's
supposed discovery of the art. But the fame genuine re-
cords go full farther back: they prove oil to have been em-
ployed in painting pictures in the chapel before the rebuild-
ing by Edward III.; that is, in the 20th year of Edward I.,
or in 1272, which was one hundred and eighteen years prior
to Van Eyck. (See Painting.) Under the old house of
lords are the cellars which were prepared for the famous
powder-plot, of the 5th of November, 1605.

Whitehall Palace.—This royal mansion occupied a con-
iderable space on the bank of the Thames, including Privy-
Garden, and extending to Scotland Yard, stretching out in
breadth from the river quite across the street still called
Whitehall into St. James's-park. It was originally the
property of Hubert de Burgh, earl of Kent, and grand
jurisdiction of England under Henry III. The situation
was low and marshy, owing to the concourse of the branch
on the west of Thorney Island with the main channel of
the Thames. In 1248 the palace belonged to the archbishops
of York, who poiffessed it until, on the fall of cardinal arch-
bishop Wolsey, it was, in 1529, feized, with his character-
istic love of justice, by the infatiable Henry VIII. Po-
feffion being obtained, many alterations were made in the
building, of which a portion, commonly called the Cock-pit,
adjoining to the Treasury, still exists. Falling into decay,
James I. resolved to rebuild Whitehall in a suitable man-
er; and for such a design the spacious ground between the
Thames and the park, and commanding both, offered every
facility excepting that of elevation of ground, without a proper
degree of which dignity is hardly attainable in architecture.
Of the magnificent, although in many parts faulty, pro-
ject of Inigo Jones, prepared for the intended work, one
portion only was executed. This is the Banqueting-houe,
so called from its succeeding, in delineation as in fact, to
a part of the old palace appropriated to royal entertainments.
The present edifice, one of the few specimens of noble and
regular architecture in the metropolis, consists of two stories,
on a rustic basement, ornamented with Ionic and Corinthian
columns and pilasters. This edifice, containing seven win-
dows on a floor, was only one of the angular pavilions of
the intended grand structure. It is sufficiently enriched, but
not overloaded with ornament; and being constructed on a
scale of very large dimensions in the parts, had the whole,
even with all the defects of the project, been carried into
effect, no sovereign in Europe could have exhibited a place
of residence to be compared with that of the king of Great
Britain. Magnitude of parts was in that project held to be
indispensable for grandeur of effect. The interior of the
Banqueting-houe has long been converted into a royal, and
lately into a military chapel; adorned, as is still most in-
congruously imagined, with trophies of war. The ceiling
is peculiarly worthy of observation, being the production of
the splendid pencil of Rubens; exhibiting the allegorical
history of his patron, James I. This masterly performance
ought to have diffused the admirers of George I. from con-
verting the room into a place of Christian worship; for
"its contents are in no way akin to devotion; and the work-
manship is so very extraordinary, that, in beholding it, the
spectator must either pollute an uncommon measure of zeal,
or be utterly delirious of skill and taste, who can attend to
any thing besides." From a window of the Banqueting-
houe the unfortunate Charles I., unfortunate in living in
times when the art of managing parliaments was either un-
known, or perhaps thought unworthy of a prince, palled to
the scaffold erected in the public street in front of his
own palace. In a court behind the building stands one of
the small number of public statues of the metropolis me-
ning examination. It is the work of Gubbins, and exhi-
bits James II., indicating, as he would do in his defined
situation, with an air and attitude full of expression, the
spot where his father suffered. At no great distance, on
the former site of the crofts in the village of Charing, is
erected another fine equestrian figure of Charles himself.
St. James’s Palace.—That the sovereign of the British empire was far less suitably lodged in his capital than are numbers of his subjects, has by foreigners been often remarked, and by natives been sometimes converted into a compliment to the sovereign and to the nation. But the fact is, that St. James’s palace was in its origin an hospital, of part of which Henry VIII. availed himself to construct the present buildings, as an appendage to the palace of Whitehall, with which it was connected by St. James’s park. Having been allotted for the residence of the princes, afterwards queen Anne, and her husband George of Denmark, St. James’s has ever since continued to be occupied for court or state purposes. The buildings are neither grand nor regular; the front, overlooking the park, has alone a certain air of dignity; and the state apartments, although they contain nothing peculiarly magnificent in the furniture of the decorations, are commodious and commodious. Connected with this palace is the park of the same name, ornamented with a long canal in the middle, and with broad walks, separated by rows of trees on the sides, the only species of improvement of which its flat situation is well susceptible. Near the centre of the canal, a wooden bridge, in the Chinese style, has been built across the water. On the north-west of St. James’s park is an open space, called the Green-park, capable, from its elevation and variety of ground, of much greater improvement: but its principal recommendation is, that, being in fact a wide extended green field, it furnishes a delightful promenade in all directions, and welcome relief from the hard pavement of the streets.

Buckingham-House.—This edifice, now settled on the present queen in lieu of Somer-fet-house, and hence called the Queen’s palace, possesses peculiar attraction, as much from its unfavourable situation as from its history. It was built by John Sheffield, duke of Buckingham, about the year 1700, and its gardens were adorned with terraces, canals, &c. The building is of brick, and most of the apartments are small. In this palace for several years were held his majesty’s levees, while his health permitted his appearance. Annexed to the palace are an octagon and other apartments, containing the king’s library, rich in various works of value, particularly in early editions of books. Interior views of the chief rooms, with an ample history of this edifice, &c. are given in Pyne’s History of the Royal Palaces.

Carlton House, the residence for a number of years of the prince of Wales, regent of the united kingdom, as formerly of the princes dowager of Wales, his majesty’s mother, occupies a situation in between Pall-Mall and St. James’s park. The chief front towards the street presents the singular incongruity of a lofty and highly enriched Corinthian portico, giving entrance into a low sufficied edifice. Between the house and the street is a court-yard, bounded by a low wall, sustaining an open colonnade, with an entablature. The interior has undergone many changes, and is fitted up in the most costly and sumptuous manner. The library, conservatory, and the armoury, are very fine and splendid. The work just referred to contains several fine prints of the different rooms; also a particular account of the house and its contents.

The ancient palace of Somer-fet-house has now disappeared, being superseded by the magnificent structures composing Somer-fet-place. Of the Savoy a few portions still exist, but much changed from their original delineation; and in a few years, perhaps, even the whole may be effaced. The plan of Somer-fet-place, as formed by sir William Chambers, was to comprehend within one vast edifice pro-
confiding of six of these circular divisions; the whole encompassed with a wall, inclosing 18 acres of ground, and calculated to contain altogether from 1000 to 1200 prisoners. Some of them are already placed, and the beneficial effects of the institution on their general conduct has already been very perceptible. As a part of Middlesex, the proper prisons for criminals are those belonging to the county; but in Tothill-fields is a bridewell for the detention and temporary punishment of petty offenders, under the charge of the magistrates of the city and liberties. The charitable establishments of Westminster for the education and maintenance of youth and the consolation of age, for the relief of disease and accidental calamity, are much more numerous and useful than splendid. St. George’s and the Middlesex hospital, (not, however, properly within the town,) the Westminster infirmary, &c. are excellent institutions, superintended by medical gentlemen of the highest professional reputation. Of the distinguished private mansions of noblemen and others, it is impossible here to do more than point out a few of the most remarkable. Among these are Northumberland-house, the only residence now remaining of our ancient nobility in the Strand; the duke of Marlborough’s in Pall-Mall, erected by the nation for the great duke John; the duke of Norfolk’s, St. James’s square; earl Spencer’s in St. James’s place; Burlington-house; the duke of Devonshire’s and earl of Egremont’s in Piccadilly; the marquis of Lansdowne’s in Berkeley-square; the earl of Cheltenfield’s in South Audley-street; earl Grosvenor’s in Upper Grosvenor-street; the marquis of Anglesey’s in Burlington-street; the marquis of Stafford’s, Cleveland-house. These are some of the best, as far as the exterior is concerned; but many others might be noticed highly deserving of attention, particularly for the admirable paintings by the best masters with which they are enriched.

**Bridges.**—It is a remarkable fact, that, great and important as Westminster is, until the construction of the noble bridge of its own name, of 15 arches, and in total length 1223 feet, completed in 1750, it possessed no other mode of communication across the Thames than by ferries, or by the embarrasmed circuit of London-bridge. The opening of Blackfriar’s-bridge was certainly a great accommodation for an extended portion of the town; but still something more was wanted, in a space between those bridges of no less than 3100 yards, or one mile and three quarters, of a most populous and active metropolis. About mid-way of this interval was opened, on the 18th July, 1817, a new bridge, leading from the Strand between the Savoy and Somerset-place, called the Strand or Waterloo bridge: it is a structure of a novel description in this country. The idea of it is not, however, new, having been frequently suggested, particularly by Gwyn in 1766. (For a particular description of this bridge, and the dimensions of its various parts, we refer to the article Waterloo.) The road-way is strictly horizontal on the level of the street in the Strand, but much above the surface of the Surrey shore, to which it descends by a long and gentle slope. Each pier, as in Blackfriar’s-bridge, is externally ornamented with two Tuscan columns supporting a square projection. The bridge was opened on the anniversary of the horrible carnage of Waterloo, and from this event it has been attempted to give it a name. In this case, however, as the main object was that of a truly solid bridge, the name would be more fitting, as Blackfriar’s and the Strand bridges. This admirable work does great honour to the engineer and architect Mr. John Rennie, and to the judgment of the managers of the enterprise; and it is, all circumstances of position, form, and materials considered, without a parallel in Europe. Besides the Strand-bridge, another of a different kind has lately been constructed over the Thames, just a mile above Westminster-bridge, leading over from Tothill-fields to Vauxhall, and thence properly named Vauxhall-bridge. The architect, Mr. Walker, has divided the breadth of the river into nine apertures, covered by frames of cast-iron, reeling on stone piers. The road is not horizontal, but forms two gently inclined planes, meeting in a very obtuse angle in the middle. The length of this light and elegant bridge is 809 feet. A third bridge, not indeed immediately connected with Westminster, but of great importance to the metropolis, is now in progress. This is the Southwark-bridge, commencing between that portion of the town and the city of London, on the line of Queen-street and King-street to Guildhall. This extraordinary structure, designed also by Mr. Rennie, consists of three grand arches of cast-iron, in segments of very large circles; the centre arch 240 feet in span, and the two others of 210 feet, each. To enable the reader to form a comparative idea of the bridges now mentioned, the following dimensions of some other remarkable bridges are subjoined. London-bridge, (see Bridge,) consists of 19 very unequal arches; Southwark-bridge (the iron part), 730 feet long, and of three arches; Blackfriar’s-bridge, 995 feet long, of nine arches; Strand-bridge, 1280 feet long, of nine arches; Westminster-bridge, 1225 feet long, of 15 arches; Vauxhall-bridge, 809 feet long, of nine arches. On the continent, the most remarkable structures of this description are the celebrated horizontal bridge over the river Loire, at Tours, in the west of France, in length 1335, and consisting of 15 elliptic arches; the bridge over the Moldau, at Prague, in Bohemia, 1700 feet long. These, however, are all far outdone by the antique bridge over the Rhone, at St. Esprit, in the south of France, consisting of a multitude of small arches, supporting a very narrow road-way, extending in all nearly to 3000 feet. This bridge has the peculiarity, that, instead of being straight, it is composed of two lines forming an obtuse angle, turned against the current, as if the water of the Rhone were too strong for it to support a straight line. The literary and scientific institutions.—These have already been noticed in the article London, to which the reader is referred. It will always be a peculiar honour for the British nation in general, and to the metropolis in particular, that, with very few exceptions indeed, all those valuable establishments for the promotion of learning, science, and the arts, which add so much splendour to the capital, owe their origin, their maintenance, and their reputation, to the voluntary exertions, personal and pecuniary, of private individuals. The two principal exceptions in London and Westminster are the British Museum, and the Academy of Painting, Sculpture, and Architecture; but from their nature, without public aid, neither of these institutions might ever have been established. (See Museum.) The British Museum is in regular and rapid progress, in the acquisition of those of high importance in the departments of natural history, literature, and art, to which it is devoted. The Elgin marbles, or the venerable monuments of Grecian sculpture, rescued by the earl of Elgin, during his embassy at the Ottoman Porte, from barbaric neglect and destruction, in their original position in Athens, are objects of attraction and importance unparalleled in Western Europe. Of the British Museum, in general, it is but justice to observe, that, in no familiar
similar establishment, can more attention be shewn to facilitate the researches, literary or scientific persons, of all who resort to the treasures it contains.

The population of Westminster very sensibly fluctuates, according to the season of the year. From October to July, while the parliament is assembled, the courts of law are sitting, and the places of amusement are open, the town is fully inhabited. During the other months, even these whose business is still transacted in town retire to their villas or quarters, in the surrounding villages and country. A hundred years ago, the inhabitants were computed, but surely overrated, at 130,000; but the last returns to parliament in 1811, they amounted to 62,085, occupying 17,555 houses.

The books examined for the foregoing account, and to which the reader is referred for more minute particulars, are, Antiquities of Westminster; the literary part by J. S. Hawkins, eq.; plates from drawings by J. T. Smith; 1 vol. 4to. 1807. The History of Henry VII.'s Chapel, by J. Britton, with plan, views, elevations, &c.; in vol. ii. of Architectural Antiquities of Great Britain. The History and Antiquities of the Abbey Church of St. Peter at Westminster, 4to. 1818, &c., by E. W. Brayley; with numerous plates from drawings by J. P. Neale. The History of the Abbey Church of St. Peter's, Westminster, its Antiquities, and Monuments; in 2 vols. 4to., with 63 engravings; published by Mr. Ackermann. An Inquiry into the Time of the first Foundation of Westminster Abbey, &c., by R. Wildmore, 4to. 1743.

The History, &c. of the Abbey Church, by the same author, 1751. Welfmonasterium, or the History and Antiquities of the Abbey Church of St. Peter, Westminster, by John Dart; 2 vols. fol. 1723. The general histories have been already referred to in the article LONDON.

WESTMINSTER, a town of Malachshhets, in the county of Worcesters, containing 1419 inhabitants; 55 miles N.W. of Boston. Alto, a port-town of Vermont, in the county of Windham, containing 1928 inhabitants; 18 miles N. of Brattleborough. Alto, a town of Maryland, with a post-office; 25 miles N.W. of Baltimore.

WESTMINSTER-Hall, an island in the straits of Magellan, situated to the N.E. of Cape Pillar. S. lat. 52° 34'. W. long. 76° 16'. Alto, an island in the Mergui Archipelago. N. lat. 16° 42'.

WESTMORE, a town of the Isle of Vermont, in Essex county, containing 71 inhabitants; 65 miles N. of Norwich.

WESTMORELAND, Westmorland, or Welfmoreland, a northern county of England, surrounded by parts of Durham and Yorkshire to the N., N.E., and E.; by Lancashire to the S. and to the S.W.; and by Cumberland on the W. and N.W. The greater part of the boundary line is artificial; but at the S. and S.W. rivers and lakes constitute natural lines of demarcation. This district is supposed to have derived its name from being a western moorish country; perhaps it was the land of the moors or lakes in the west. It formed a part of the territory of the Brigantes in that district occupied, according to Richard of Cirencester, by the Pohunites and the Sibunites. The Brigantes were the principal inhabitants of the Roman province Maxima Caesariensis; and during the heptarchy were included in the extensive kingdom of Northumberland. In the time of Edward the Confessor, this kingdom was divided into five shires, of which one was called "Appelbyshire, to which belonged the land of Welfmoreland."

In this division, however, Kendal and its district were not included; for long after the Norman Conquest, they were reckoned to belong to the hundred of Lonsdale, in Lancashire. Of the Roman establishments in Westmoreland, many noticeable vestiges are to be found in flatlands, forts, roads, inscriptions, and other remains. Among the flatlands, or towns, may be mentioned Amboglana, a name supposed to be still preferred in Ambleside, at the N. end of Windermere; but Horley places Diesu at that town. At any rate, bricks, urns, coins, and other relics, sufficiently prove it to have been occupied by the Romans. Verdares, another Roman flatland, was situated where now stand Brough-nader-Stannmore, a name announcing an ancient fortification. Amboglana seemed naturally to have given rise to the modern name of Appleby; but no Roman remains have ever been found at that place, although it be undoubtedly of considerable antiquity. Galacum is by Camden placed at Whelp, but by later writers near Appleby. Brocas is probably Brougham castle, near Penrhys. This flatland has often been confounded with Broconas, of which remains exist in Kirkbythore. This flatland Whelp or Whelp castle lies in the middle of the village, and is commonly called High Burwards. It occupies an advantageous position; the extent from west to east is about 160 yards. The foundations of the wall are very plain. Among the inscriptions found in it is one Fortuna Seruatriis. A branch of the great Roman road, called the Watling-street, passed through the county from Stanmore to Brougham castle; and until the modern turnpike-road was made, the former was very conipicious almost all the way. Between Brough and Kirkby, parts of it are still to be observed; keeping, as was the practice of the Romans, a straight course, regardless of difficulties. This road measured about six yards in width, and is described to have been formed, in many places, by three courses of large square stones. Near the northern border of the county, and not far from Kirkbythore, is a large enclosure, attributed to the Romans, and measuring about 300 yards in length, by 150 in breadth. It is represented as having twelve entrances, with bastions to each; but this is improbable. Some topographers describe a few of the antiquities of the county as of Celtic, or Druidical origin; particularly a "fort of Druidical place of worship near Shap." Maybrough castle, and Arthur's Round Table, near Penrhys, are referred to the British era. There are also several cairns, or heaps of loose stones, in the county. At Kirkbythore, a Roman road, called the Maiden-way, branched off, and passing over the lower end of Crossfell, terminated at Cawvolin, in Northumberland. Roman inscriptions have been found in various parts of the county. In one particular was discovered at Kirkbythore, inscribed Deo Bolatucodo, a local divinity probably of the original Britons. In 1739, at the same place, was found a stone inscribed Jovi Serapiis. In the manor of Milburne was found an altar to Silvanus, within a round fort surrounded by deep ditches, called Green-castle. This county is divided into the two baronies of Kendal and Westmoreland, the latter of which is occasionally called the barony of Appleby; and these again subdivided into the four wards of Eal, West, Kendal, and Kirkby Lonsdale. In ancient times, the Kendal barony was deemed part of the county of Lancashire. In the Domestic survey, an account is taken of some places in the barony of Kendal, with some neighbouring property in Lancashire and Yorkshire; but the Westmoreland district is unnoticed in that record, and hence supposed to have been uninhabited and waste at the time of the Conquest. The Kendal barony is in the diocese of Cheltenham, and consists of two rural deaneries; whereas the other barony is within the diocese of Carlisle, and consists of one
one rural deanship. The whole county contains only thirty-two parishes. According to the census of 1811, these contained 9064 houses, and 45,922 inhabitants.

The general appearance of Westmorland is marked with some of the strongest features in nature; immense tracts of mountains, beautiful but contracted valleys, extensive lakes, and large rocky districts, which contain many high, steep, and bulging crags. The county is not only encircled with mountains, but the greatest part of its interior surface is swelled into hills. A long range of heavy-looking hills bounds the eastern side of the county; in front of which is an extensive tract of tolerably level ground. The rest of Westmorland is almost wholly hill and dale. The farmhouses and those of the small villages, covered with blue slate and whitened with lime, are seated about the bases of the hills, with their small irregular fields spreading up the sides of the mountains, and almost universally divided with stone-walls. This last circumstance gives the county a naked appearance; but the numerous tracts of woodland interpersed tend to enliven the scene. Every dell or hollow has its little brook, and the small plots of these are plentifully supplied with fish. Several low heathy commons are seen towards the eastern side of Westmorland; and the western part is characterized by high rugged prominences, and even some rocky plains, small coppices, and a large extent of low flat peat-moors; on the north, the fine woods about Lowther add a striking feature to the landscape. Such are the brief but general outlines of the picture; we proceed to particularize some of its peculiar characteristics, the most prominent of which are its Mountains. These are provincially called fells, of which the following are the most noted.

Farrington, near the borders of Lancashire, is a very picturesque lime-flone rock; from the Kendal road, near Burton, it is said to have very much the appearance of the rock of Gibraltar.

Whitbarrow-peak is also a very high rock, and in some parts presents a perpendicular face of folio lime-flone. It rises its grizzly front between Minthorpe and Cartmel. The high road leads along its base, whence it presents a grand, and in some places a tremendous aspect.

Langdale-pikes, in the western corner of the county, are conical hills of great height, with pyramidal rocky tops, and are situated in the interior parts of a very mountainous district; their sides and bases are verdant, and have formerly been covered with wood.

Hartfell, High-street, and Kidney-pike, are stupendous heights, within a few miles of the southern end of Haweswater. From the top of High-street, thirteen lakes, and the sea in several directions, may be seen.

The chain of hills on the east, which is continued north and south through other counties, presents a heavy and regular appearance; and they have mostly mellow and healthy tops, except two or three conical green hills opposite Appleby. They are in general picturesque; some with abrupt declivities, or rocky fronts, form high precipices, or in bulging shattered crags project over the vales in a frightful manner; while others show smooth, verdant, and swelling surfaces, beautifully spotted with flocks of sheep and herds of cattle.

There are few Caves in Westmorland; one, however, is to be found at Dun-fell, bordering on Cumberland, and is of considerable extent. So intricate are the different galleries and chambers of this capacious cave, that the Rev. William Richardson is said to have been seven hours in examining its varied parts. He describes the roof in some parts to resemble pointed arches, in others flat surfaces; he found in some places the *flataedite*, and pieces of *rhomboidal spar*. He travelled nearly two miles in a right line, and discovered evident marks of some of the chambers having been filled with water. The highest part of the vault is rather more than 25 yards; the breadth in some places about 150 yards; in other parts there was scarcely height sufficient to creep through the hollow. Some other visitors have mentioned the astonishing height of the pikes, with which these vaults are encroached on. Nicholson and Burn, in their "History of Westmorland," mention three pits, one of which is generally considered unfathomable. In the fasons of salmon smelts, these pits abound with those smelts, when they are to be seen also in the river Kent, which induces a belief that they arrive from thence in subterranean passages.

Rivers.—Although the rivers or streams, (provincially called beck,) are numerous, they are but small, and mostly rise within this district. Only three of these are sufficiently important to retain their original names from their sources to the sea. These are, the Eden, the Lune, and the Kent, or Ken. The first springs in Mallerfield, and runs north, and having received in its course, besides many lesser streams, the conjoined rivers of Lowther and Eamont, enters Cumberland, which county it travesses in its course to the sea, at Rowell. The Lune, or Lyn, hath its source in Ravanstonedale, and passing to the south, through a fine vale, to which it gives name, enters the county of Lancashire, formerly called Joncaster. The Ken, or Kent, has its origin in Kentmere, and runs through a valley, called Kendal; passes the town of Kendal, and empties itself in the sea at Crambo Bay. The different rivulets from the eastern district empty themselves into the Eden, which, during its course through this county, receives its principal supplies. An irregular line, drawn east and west through the centre of Westmoreland, divides the direction of its several rivers; those on the north falling into the Eden, either before or at its entrance into Cumberland, except two or three small branches of the Tees, which rise on the eastern ridge of hills on the borders of the county of Durham. The rivers on the southern parts take a contrary direction, and enter the sea at different places.

The Lowther has its source in the Moors, above Wet-ladda, and passing Upgill-hall, there unites with Swindale-beck, which rises near the large-quiaries; with the augmentation of a few other streams, it joins the Eamont.

The Eamont emerges from Ulls-water, and forms a boundary to parts of this county and Cumberland; and after being augmented by the waters of the Lowther river, which descends from the centre of the county, it joins the Eden as it enters Cumberland.

The Lune, or Lyn, has been described in a previous volume of this work, under Lancashire.

The Crake, a brook or rivulet, descending in several heads from a variety of dells on the side of Brackenthal-fell, passes through a very extensive peat-moss to the Ken, just before its influx to the sea.

The Winter, or Winler-beck, forms the boundary between the lower part of Westmoreland and Lancashire. It rises on the hills about two miles east from Windermere lake, and directs its course southwards, when it discharges itself in an estuary of the sea.

The Trout-beck is a brook issuing from the mountain High-street, and unites itself with Windermere lake.

Rothay springs on the borders of Cumberland, among a number of high mountains; it runs several miles westward, and receives various streams in its progress to Grasmere.

Lakes.—Westmoreland is deservedly celebrated for its fine
fine lakes. Among these, Windermere, or Winandermere, and Ulls-water, merit particular attention for size, and for the picturesque beauty of the scenery which surrounds them. They may be, and are by competent judges, regarded as unequalled in the kingdom.

Winandermere is a large lake of about ten miles and a half in length, by a breadth of from one to two miles; including an area, or sheet of water, of nearly 4534 acres. Its depth is in one place 23 fathoms, in a second 29, and in a third 31 fathoms. Four mountain streams, or rivers, supply this lake, and it is singular that its waters scarcely ever appear to be augmented or decreased. "Even in the most violent rains, when the country is drenched in water, when every rill is welded into a river, and the mountains pour down floods through new channels, the lake maintains the same equal temper; and though it may spree a few yards over its lower shores, (which is the utmost it does,) yet its increase is seldom the object of observation; nor does the severity of the greatest drought make any considerable alteration in its bounds." In this lake are thirteen islands, the largest of which is now called Curwen's island. It contains about 27 acres of land, which are laid out in pleasure-gardens, walks, &c. around a very handsome mansion belonging to Mr. Curwen.

Ulls-water, part of which is known by the name of Ouvel-mer, is a large and long lake, situated at the north-western extremity of the county, and partly in Cumberland. Next to Windermere, it is the largest sheet of water in this part of England. It covers an area of about nine miles in length from N.E. to S.W. by two in the broadest part, though the general width rarely exceeds a mile. Its sides are very irriguous, and from its shores the mountains rise in various bold, picturesque, and romantic forms; occasionally starting abruptly from the lake, and in other places ascending by gradual slopes. Towards the south-western end the mountains are on the grand scale. On the northern and western sides the scenery is mostly rocky and woody. In some places its waters are from 20 to 35 fathoms deep. It abounds with trout, perch, skelles, and eels; also some char, and a large species of trout, some of which have been caught of ten pounds weight. In its highest part are a few small rocky islands.

Haws-water, in beauty and extent, ranks next. This lake is situated between Shap and Ulls-water, in a mountainous district; it is about three miles in length, and in breadth from a quarter to half a mile. The hills on the east side are high and rocky, and partially covered with wood. Those on the west are also high, but have a portion of low cultivated ground along the margin, which is divided into small farms. The narrowest part of the lake is said to be fifty fathoms deep.

Grasmere lake is a small but beautiful sheet of water, about a mile in length, and nearly a mile broad, having its margin indented with numerous small bays with lofty and rocky eminences. Its situation is a few miles north of Ambleside. Near its centre is a small green island. The poet Gray describes this lake and its scenery. He says, "After passing the romantic mountain of Helm-Crag, he says, "opens one of the sweetest land lakes that art ever attempted to imitate. The bosom of the mountains here, spreading into a broad baion, discovers in the midst Grasmere-water; its margin is hollowed into small bays with bold eminences, some of rock, some of turf, that half conceal and vary the figure of the little lake they command. From the shore a low promontory pushes itself far into the water, and on it islands a white village, with the parish-church rising in the midst of it." South of this, in the same vale, is Rydal-water, a small lake nearly a mile in length, and intersected with wooded islands. Its water is slow, and abounds with reeds.

On an elevated situation, nearly two miles west from Ambleside, is a small lake called Elter-water. Broad-water is a small lake half a mile long, and a quarter of a mile broad, situated a few miles above Ulls-water.

Kentmere-tarn, a piece of water upwards of a mile long, and nearly half a mile broad, is situated in Kentmere-dale.

Skeggle-water, a very small lake, three miles north-east of Kentmere-tarn, is embosom'd in the mountains of Longfledg'dale.

Sumbiggen-tarn, and Whin-fell-tarn, are small pieces of water; the former four or five miles east from Orston, well supplied with eels and a red trout, refembling char; and the latter about five miles north-east from Kendal.

The soil of Westmoreland is mostly dry and gravelly; but in the east and north, sand and hazel-mould are found. Clay prevails on a few farms towards the Eden and the eastern hills; and a moist soil appears in some northern districts. Peat-mofs abounds on the tops of some high mountains, consisting of a dry soil upon a hard blue rock, provincially called rag. The soil that lies upon a stratum of lime-flone is esteemed the most profitable.

The roads in Westmoreland, from the rocky nature of the country, are very firm and good. These are generally formed to wind gradually round the sides of the hills and along the vales, in such a manner, that the declivities of the former are mostly avoided. The principal roads leading through this county are those from Scotland and Cumberland to London, and on the southern parts of England. These roads are united through Cumberland, but divide near Penrith, on the confines of Westmoreland: one turns eastwards, over Stainmoore, and through the centre of Yorkshire, to London, &c.; the other proceeds directly south, through Kendal, Lancaster, &c. to Manchester, Liverpool, Wales, the western counties of England, and also to London. A branch from this road goes through Kirkby-Lonsdale to the manufacturing towns in the West Riding of Yorkshire, and other southern districts.

Before the rebellion of 1715, the public roads of this county were almost impassable; but in that year the government planned several new roads: very little, however, was done to them before the more serious insurrection of 1745. This event impelled the government to direct some effectual repairs to be made. In 1774 an act of parliament was obtained to make a turnpike-road from Bowes to Brough. In this year, the first stage-coach from London to Glasgow was established to run this road. A mail began to travel through Kendal, &c. from London in 1786. Since which time the great roads have been kept in very good repair.

With the exception of some trifling veins of lead ore, few minerals have been found in the eastern part of this county. Coal is obtained only in the south-eastern extremity of Westmoreland, except an inferior quality called crown-coal, procured in the neighbourhood of Shap.

The county affords various sorts of valuable flone; particularly lime-flone, marble, gypseum, blue flate, and freestone. There is great abundance of lime-flone, except among the western hills.

Marble of a beautiful kind was discovered a few years ago on the banks of the river Kent, near Kendal, and has been worked with success. The same vein has also been found on the opposite side of the river.

Blue flate of various sorts is dug from the rocky hills on the
the western side of the county; though great quantities are used in the country, yet much of the better sort is sent to London, Liverpool, Hull, and other large sea-ports. Beds of lime-flour are generally incumbent on beds of slate.

The buildings of Westmoreland are distinguished for their neat appearance. The houses are mostly built with lime-flour, or blue rag; thatched roofs are common, but slate is more generally used. In farm buildings, the barn is usually built upon the cow-house and stable, a method which requires the slope of a hill, as carts are carried along a level on one side into the barn. As very little corn or hay is stacked without, the barns are necessarily very spacious. There are many noxious and gentlemen’s feats in this county; and also some pleasant villas which ornament the borders of the lakes.

The commerce of Westmoreland is not extensive. Its exports are chiefly a coarse woollen cloth, stockings, flates, tanned hides, gunpowder, hoops, charcoal, hams, wool, sheep, and cattle.

The manufactures of the county consist of silk and worsted waistcoat-pieces, knit worsted stockings, flannels, tanned leather, and gunpowder.

Formerly the whole county was governed by military tenure, i.e. by homage, fealty, and cornage, which last drew after it wardship, marriage, and relief; and the service of this tenure was military service. Cornage appears to have been peculiar to the border-service against the Scots. Cornage, horn geld, and notgeld, were probably synonymous, and implied annual payments of horned cattle, to provision the garrisons. The lord’s rent was called white rent, probably from its being paid in silver. Scutage, or service of the shield, was another compensation in money, instead of personal service against the Scots.

Some veins of copper ore have been found and worked in different parts of the county; but the product has not been found sufficient to defray the expense of workmanship. Before the year 1704, great quantities of lead were found near Hartley. Some mines at Dunfell have proved very productive of this metal for many years, but latterly there has not been much ore found. At Dunton are some rich and productive lead mines, belonging to the earl of Thanet. There are some considerable mines at Greenhills, near Patterdale, and at several other places in the county. This metal is obtained in various quantities.

Croft-fell, the highest of the chain of mountains which extend along the southern frontiers of the county of Westmoreland and Cumberland, is said by Robinson, in his Natural History of the County, to have been formerly called Fiend’s-fell, from evil spirits which are said in former times to have haunted its summit, and continued their haunts and nocturnal vagaries upon it until St. Auffin, as is reported, erected a croft, and built an altar upon it, whereon he offered the Holy Eucharist, by which he counterchanged those hellish fiends, and disturbed their haunts. Since that time it has been named Croft-fell; and unto this time there is a heap of stones on the summit, which bears the name of Croft-fell.

Upon this and the adjoining mountains occurs the phenomenon called the Helm-wind, which, in spite of St. Auffin’s charms, continues its vagaries on its ancient haunts. It is peculiar to this district, and the confines of Lancashire and Yorkshire, about Ingleborough, Pendle, and Penigent. It also occurs on Wildboar-fell, in Ravendale; and is most prevalent in the months from October to April. The appearances attending it are a whitish cloud hanging half way down the mountains, but keeping an exact parallelism with every plane, depression, and elevation of their tops, which it covers as with a helmet. Above this appears the blue sky, and then a white cloud, called the helm-bar, from an idea that it reproves the fury of the storm; it continues in a tremulous agitated motion till it disperses; and then the hurricane issues forth, roaring along the sides of the hills, and frequently extending two or three miles from their sides. The following are the heights of the principal mountains, as ascertained by Mr. Dalton. Helvellyn is 1070 yards high. A deep drift of snow was seen on this mountain on the 12th of July, 1812. Bowfell and Rydal-head are each 1030 yards in height. The High-fret is 912 yards high. On its summit are annual horse-races, and other sports, on the 10th of July, to which every one brings the sheep that have strayed into their heath-ground, for their owners to challenge.

It appears that different grammar-schools were established in this county previous to the dissolution. Edward VI. was patron of the school at Kendal; and queen Elizabeth founded schools at Appleby, Kirkby Stephen, and Kirkby Lonsdale. From these seminaries many learned men have been distributed over England, some of whom have obtained eminence in the literary world. They have also contributed towards the establishment of other public schools in the county. Seminaries are, therefore, established in nearly every village in Westmoreland.—The History and Antiquities of the Counties of Westmoreland and Cumberland, by Joseph Nicholson, Esq. and Richard Barn, L.L.D. 2 vols. 4to. 1778. An Essay towards a Natural History of Westmoreland and Cumberland, by the Rev. Thomas Robinson, 8vo. 1799. General View of the Agriculture of the County, by Andrew Pringle, 4to. 1794. Observations relative chiefly to Picturesque Beauty of the Mountains and Lakes of Westmoreland and Cumberland, by the Rev. William Gilpin, 2 vols. 8vo. 1788. A Survey of the Lakes, by James Clarke, folio.

WESTMORELAND, a post-township of New York, in Oneida county; 10 miles W. of Utica, and 107 miles from Albany. Its waters are small; its surface very level, but the soil is very rich and fertile. It has a church for Congregationalists, and a competent number of common schools. In 1810, the population was 1135, and the senatorial electors were 141. Allo, a county of Pennsylvania, containing 26,392 inhabitants, of whom 20 are slaves. Allo, a county of Virginia, containing 8102 inhabitants, of whom 4080 are slaves. Allo, a township of New Hampshire, in the county of Cheshire, on the E. bank of the Connecticut, containing 1917 inhabitants; 5 miles N. of Chesterfield.

WEST NANTMILL, a township of Pennsylvania, in the county of Chester, with 1188 inhabitants.

WEST NORTHERN LIBERTIES, a town of Pennsylvania, in the county of Philadelphia, containing 9795 inhabitants. Allo, a township of the same, containing 168 inhabitants.

WEST NOTTINGHAM, a township of Pennsylvania, in the county of Chester, with 642 inhabitants.

WESTOE, a township of Durham, with 2900 inhabitants; 2 miles S. of Shields.

WESTON, a township of Connecticut, in the county of Fairfield, with 2618 inhabitants; S. of Fairfield. Allo, a town of Vermont, in the county of Windor, containing 629 inhabitants; 30 miles N.N.E. of Bennington. Allo, a town of the state of Massachusetts, in the county of Middlesex, containing 1008 inhabitants; 12 miles W. of Boston.

WEST PENNSBOROUGH, a township of Pennsylvania, in the county of Cumberland, with 1264 inhabitants.

WESTPHALIA, a circle of Germany, bounded on
the N. by the Dutch states, on the W. by the Netherlands, and elsewhere by the circles of the Rhine, Upper and Lower. The ancient Saxons were divided into Westphalians, Angrians, and Estphalians. The people inhabiting between the Weser and the Rhine, were called Westphalians, and the tract of country inhabited by them, has from thence been called Westphalia. The duchy of that name, in the electoral circle of the Rhine, constituted a part of this country; but the circle of Westphalia comprised also under it other countries, which never belonged to the above-mentioned Westphalia. And thus we must carefully distinguish from each other the three denominations, which are, the circle of Westphalia, Westphalia itself, and the duchy of that name. Formerly, not only certain states were reckoned in this circle, which at present no longer belong to it, as Utrecht, Gelderland, Zutphen, the bishopric and city of Cambrai; but in other respects, also, the ancient and the modern limits of the countries of the Westphalian circle differ greatly from each. The following appeared to be states of the Westphalian circle before the peace of Lunville, viz. the bishoprics of Paderborn, Munster, Liege, and Osnabruck; the duchy of Verden; the principality of Minden; the abbeys of Corvey, Stablo, Werden, Cornelius Munster, Effen, Thorn, and Hervorden; the duchy of Cleves, with the county of Mark; the dukeries of Juliers and Berg, Naffau Siegen, and Naffau Dillenburg; the principalities of East Frisia and Meurs; the counties of Sayn, Wied-Runkel, Schaumburg, Oldenburg, Delmenhorst, Lippe, Bentheim, Tecklenburg, Hoya, Vinnenburg, Diepholz, Spiegelberg, Rietberg, Pyrmont, Gronsfeld, Reckheim; the bishoprics of Anhalt and Winneburg; the county of Holzapfel; the bishopric of Witten, Blankenheim, Gerboldstein, Gehmen, Gimborn and Neutadt, Wickerad, Mylendonk, and Reichenstein; the county of Kerpen and Lommersum; the bishopric of Schieden, and the county of Hallermund, to which in the matricula are reckoned moreover to belong the bishoprics of Dyck, Severn, Kniphafsen, Keyl, Mechemann, Eyfs, Schlenaken, Wybri, Richold, Dreyz, and Schonau, together with the cities of Cologne, Aix-la-Chapelle, and Dortmund. The summoning princes, and directors of the circle, were the bishop of Munster, and with him alternately the electors of Brandenburg and Palatine, as dukes of Cleves and Juliers, both of whom in this directory enjoyed together but one voice. The dioceses of the circle were usually appointed at Cologne. The archives belonging to it were kept at Duffeldorf. The contribution of this circle in men and money, to the aids of the empire, was made equal to the contributions of Upper and Lower Saxony, Burgundy, and Swabia, and rated at somewhat more than the ninth, but less than the tenth part of the whole farm granted by the empire. With respect to religion, this circle was one of the mixed. Indeed the Catholic states used to nominate two, and the Protestant also the like number of affereors, to sit at the Imperial and chamber court of the empire. By the peace of Lunville, all that part of the circle which lay on the left bank of the Rhine, was ceded to France.

Westphalia, (Duchy of,) a country of Germany, bounded on the N. by the bishopric of Munster and county of Lippe, on the E. by Paderborn, Waldeck, and Helff; on the S. by Wittgenstein, Naffau, and Berg; and on the W. by Berg and Mark; about forty miles in extent from N. to S. and thirty-two from E. to W. Agreeably to its natural situation, this country is divided into three parts. The first of these, called the Hellenge, is low, and produces plenty of corn and other necessaries, with a sufficient breed of cattle and falt-springs. The second is the Haarfrank, which stands somewhat higher, between Hellenge and the Sunderland, and has indeed a good, but not so fruitful a soil as the Hellenge. The third is the Sunderland commonly called the Surland, or Saurland, which consists of hills and vales. This tract indeed is neither of great, nor even a sufficient fertility in corn; but, on the other hand, it has fine woods and meadows, together with a good breed of cattle, game, and fish, in particular trout, as also plenty of iron ore, calamine, lead, copper, silver, and gold. The principal rivers are, the Ruhr, the Lenn, the Dimel, and Lippe. The duchy of Westphalia contains in it thirty-five towns. Henry, duke of Bavaria and Saxony, being put under the ban by the emperor Frederick I. in the year 1180, the latter made a donation of the duchy of Westphalia, as also a part of the duchy of Engern, which belonged to the former, to the archbishopric of Cologne, and invested therewith the archbishop Phillip; concerning which donation, in the same year, a record, or instrument, was executed at Gelmhausen, and the said donation confirmed afterwards in the year 1200, by the emperor Otho IV., as also in the year 1204, by the emperor Philip. In the year 1368, Godfrey, the last duke of Arenberg, and his con- fort Anne, ceded the county of Arenberg to the archbishopric of Cologne; and, in the year 1371, the emperor Charles IV. invested the archbishop Frederick therewith. The county was afterwards added to the share of the duchy of Engern. The archbishops and electors of Cologne governed this duchy, till the year 1442, by marshals, but afterward under the direction of an electoral bailiff. Brilon is the capital. In 1802, the duchy of Westphalia was given to the prince of Hesse-Darmstadt.

Westphalia, a kingdom formed of several principalities, taken from the king of Prussia, after the battle of Friedland, and accorded to at the peace of Tilsit. Westphalia is divided into eight departments. 1. That of the Elbe; consisting of the greater part of the duchy of Magdeburg, with the Old Mark of Brandenburg. Its population is 253,000 souls: the chief place Magdeburg. 2. That of Fulda: the chief place Caelf. It is composed of a part of Lower Hesse, of the counties of Paderborn, Corvey, Minden, &c. Its population 239,502 inhabitants. 3. That of the Harz: chief place Heiligenstadt. It consists of Eichsfeld, of the cities of Muhlhausen and Nordhausen, of the principalities of Hohenstein, Grubenhagen, Blankenburg, &c. Its population is 210,989 souls. 4. That of the Leine: chief place Gottingen. It is composed of a part of the principality of Grubenhagen, and of the counties of Hildenheim, Brunfick, and Helff. Its population is 145,537 souls. 5. That of the Oker: chief place Brunfick. It is composed of the greater part of the duchy of Wolfenbuttel, and the bishopric of Hildesheim. Its population is 267,878 souls. 6. That of Saal: chief place Halberstadt. It is composed of the principalities of Halberstadt, Wernigerode, Quedlinburg, &c. The population is 205,222 souls. 7. That of the Werre: the chief place Marburg. It consists of Upper Hesse, the Hersfeld, &c. The population is 254,000 souls. 8. That of the Wefer: the chief place Osnabruck. It consists of the bishopric of Osnabruck, a part of Schaumburg; and its population is 334,000 souls.

Westphalia-Ham. See Ham.

Westpond plantation, in Geography, a town of the district of Maine, in the county of Kennebec, containing 481 inhabitants.

Westport, a township of Massachusetts, in the county of Bristol, incorporated in 1787, with 2585 inhabitants; 60 miles S. of Boston.
WESTPORT, a sea-port and port-town of Ireland, in the county of Mayo, situated on a beautiful bay, wooded to the water's edge, in the S.E. angle of that large haven called Clew bay, founded by the late marquis of Sligo, whose residence was within half a mile of it. Westport is a neat regular well-built town, 123 miles W.N.W. from Dublin, and 8½ S.W. from Galway. The following account, extracted from a late report to the Linen Board by Peter Bernard, esq., shews what judicious indulgence and liberal protection on the part of a landlord, affiicted by the exertions of an industrious individual, may do. Were the example universally imitated, many squalid and decayed villages would quickly acquire a more comfortable and exhilarating aspect. "The establishment and success of the linen manufacture in Westport, is due to the persevering attention of the marquis of Sligo and Robert Patten, esq. The latter, most fortunately for the neighbourhood, settled here in the year 1787; at that period Westport was a very incalculable town, containing but few houses, and its general market attended only by two or three hundred persons; now it is a beautiful well-built town, with 3000 industrious inhabitants, and many gentlemen of the highest respectability residing in it. Its market at present (1817) is attended by from 4000 to 5000 persons, whole manners, appearance, and dress, bespoke most strongly the happy effects of a well-regulated system of industry." "The first linen-market was held in 1790. For the first five years it produced only eight webs per week, and Mr. Patten was the only buyer; but he, by giving fair and liberal encouragement to the weavers, gradually but firmly advanced the trade, which now stands on a foundation not likely to be shaken. An accession of settlers from Ulster in the years 1797, 98, and 99, who brought their looms, some capital, and their accustomed habits of industry, completed what Mr. Patten had so fortunately begun." At present the market is held every Thursday in a spacious linen-hall built by the marquis of Sligo, where the goods are measured by a machine. The linens are all seven-eighths of three different qualities, and are all brought to market in a brown state. There are sold weekly about 200 webs, the value of which is estimated at above 20,000l. per annum. There are about 150 weavers and about 20 buyers, two of whom have bleach-greens at Westport. Mr. Patten has also successfully introduced at Westport the provision and corn-trade, and also the oil-bufinsels, which is carried on to a considerable extent, and gives employment in the seafaring to a great number of fishermen and boats. In March and April a number of fish appear off the coast, which, from appearing only on a funny day, the inhabitants call fun fish, though they differ from the fish usually so called. The fishermen strike these with harpoons, then cut out the liver, and abandon the rest of the fish, the liver being sufficient to load one boat of four tons burden. A large fish yields eight barrels of oil and two of tallow. This trade amounts to some thousands annually, and Mr. Patten's house has often bought in one year near 3000l. worth. The oil is esteemed as good as spermaceti oil, and is particularly well-suited for lamps, as it has no offensive smell. The price of the present day is five shillings per gallon; the dregs are used by tanners. Bernard's Report to the Linen Board in 1817.

WESTRAY, one of the Orkney islands, terminating the cluster on the N.W. quarter, is situated 20 miles N. from Kirkwall, and 347 miles in the same bearing from Edinburgh. Its shape bears some resemblance to that of a crofs; of which the longer part extends about eight miles, the arms or transverse part not more than five, and comprehends in the whole about fourteen square miles. The island comprises two parishes, St. Mary's and Crofs Kirk; and in the population return of the year 1811 was rated to contain 248 houses, and 1396 inhabitants. The only manufacture is that of kelp, of which are produced on an average 300 tons annually. Much corn is raised, but of an indifferent quality; the grass is excellent for the dairy, and for the pannage of black cattle; and the boisterous seas which surround the island afford great plenty of fish, of a very superior kind. On the eait and north are two bays; but the only harbour that can be depended on is on the north-east, and this is fit for small vessels only: formerly it received ships of much greater burthen; but from the blowing of the land the water has become so shallow, they are now compelled to anchor in a more open road. In two extensive plains near the sea-fide, one on the south, the other on the north part of the island, a multitude of graves have been discovered, all formed in nearly the same manner; and, though tradition is silent, they were probably formed after a singular conflict at some remote period: some of these graves, on the north side, have been opened, and were found to contain skeltons in a reeking posture, with weapons, domestic utensils, and several other articles, the use of which could not be ascertained.—Beauties of Scotland, vol. v. Orkneys, 1808. Carlyle's Topographical Dictionary of Scotland, 1813.

WESTRINGIA, in Botany, was so named by the author of the present article, in honour of Dr. John Peter Wellring, physician to the king of Sweden, member of the Royal Society of Stockholm, and author of several learned papers on the Lichen tribe, published in the Transactions of that body. He has also published several numbers in Svo. on the dyeing properties of many Swedish lichens, comprehending a full history of the modes of applying them to use, and accompanied with most elaborate and complete colour figures, drawn by the celebrated professor Acharius himself.


Gen. Ch. Cal. Perianth inferior, of one leaf, tubular, somewhat bell-shaped, with five fides and five prominent angles, but no furrows, divided about half way down into five equal, erect, lanceolate, beardless legs, segments, permanent. Cor. of one petal, ringent, twice as long as the calyx: tube the length of the calyx, hairy in the throat; limb two-lipped; the upper lip flat, erect, divided, rather the longest; lower in three oblong, equal, spreading, entire segments. Stam. Filaments four, shorter than the limb, divericated, the two upper ones longest; authors of the two upper flaments roundish, halved, those of the two lower deeply divided, imperfect. Pfi. German in the bottom of the calyx, four-lobed; style thread-shaped, the length of the longer flaments; stigma small, cloven, acute. Peric. none, except the hardened calyx. Seeds four, obovate, naked.

Eff. Ch. Calyx five-cleft half way down, five-fided. Upper lip of the corolla flat, cloven; lower in three deep equal segments. Stamens ditant; the two upper with halved anthers; two lower with divided abortive ones.

A genus of New Holland shrubs, chiefly from the colder parts of that country, having the appearance of our rosemary, delitute of glands, but moily downy. Leaves whorled, entire. Flowers axillary, solitary, on short stalks, with a pair of bractes close to the calyx. Corolla white, sometimes dotted with purple or violet. One species only was, for a long time, known to us, but Mr. Brown has
West

1. W. rosmariniformis. Rosemary-leaved Welfringia. Sm. in Stockh. Trans. for 1797, 175. t. 8. f. 2. Tracts 282. t. 3. Brown n. 1. Ait. n. 1. Donn. Cant. ed. 5. 141. (W. rosmarinacea; Andr. Repof. t. 214. Cumila fruticosa; Wild. Sp. pl. v. 1. 122.)—Leaves four in a whorl, lanceolate, revolute; thin and nearly smooth above; silky beneath. Calyx filiky; its teeth longer than the tube.—Native of New South Wales, near Port Jackson, from whence specimens and seeds were lent by Dr. John White, in 1791. The stem is shrubby, several feet high, very much branched; branches either opposite, or four together, square, silky with white close hairs, densely leafy. Leaves spreading, an inch or somewhat less in length, acute, single-ribbed, entire; dark green, and polished above; white with silky hairs beneath. Footstalks broad and very short, silky, without stipulis. Flowers about the upper part of the branches, shorter than the leaves; their corolla spreading nearly an inch, white, dotted about the mouth with violet spots. Anciis violet. The calyx is filiky on the outside of the tube, its segments naked with revolute margins; they appear to us variable in length. The plant is slightly bitter, not aromatic; nor have the flowers any scent.

2. W. Dampieri. Dampier's Welfringia. Br. n. 2. Ait. n. 2.—"Leaves four in a whorl, linear, strongly revolute; nearly smooth above; hoary and opaque beneath. Calyx hoary and opaque; its teeth half the length of the tube."—Gathered by Mr. Brown on the southern coast of New Holland. Sent to Kew in 1803, by Mr. Peter Good. It flowers in the greenhouse, from May to July. Alton.

3. W. rigid. Rigid Welfringia. Br. n. 3.—"Leaves three in a whorl, linear-lanceolate, divaricated, sharp-pointed, revolute; smoothish above; hoary beneath. Calyx hoary; its teeth half the length of the tube."—Discovered by Mr. Brown, in the fourth part of New Holland.

4. W. cinerea. Grey Welfringia. Br. n. 4.—"Leaves three in a whorl, linear, spreading, pointed, revolute, hoary on both sides. Calyx hoary; its teeth scarcely a quarter the length of the tube."—This was found by Mr. Brown, in the same county as the last species.

5. W. angustifolia. Narrow-leaved Welfringia. Br. n. 5.—"Leaves three in a whorl, linear, spreading, revolute; roughish on the upper side; hoary beneath. Calyx hoary; its teeth half the length of the tube."—Found by Mr. Brown, in the island of Van Diemen.

6. W. longifolia. Long-leaved Welfringia. Br. n. 6.—Leaves three in a whorl, linear, revolute; rough with minute points on the upper side; slightly hairy beneath. Calyx somewhat hairy; its teeth equal to the tube.—Gathered near Port Jackson by Mr. Brown. We have specimens, gathered in that country by Dr. White, whichiffer to the specific character, except that the back of their leaves, as well as the calyx, are rather hoary than, as Mr. Brown says, green, and the leaves are four, or even five, in a whorl. The corolla is externally downy; but this last character is, perhaps, not peculiar to the present species.

7. W. glabra. Smooth Welfringia. Br. n. 7.—"Leaves three in a whorl, linear-lanceolate, flat, smooth on both sides, as well as the calyx."—Gathered by Mr. Brown, in the tropical part of New Holland.


The two last species seem to differ remarkably from all the foregoing, in the flatness and smoothness of their leaves.

West

WEST STRIZ, in Geography, a river of the duchy of Soria, which runs into the Luffnitz, near Furtenfeld.

WESTS, a town of Virginia; 4 miles S.W. of Leeburg.

WEST SALEM, a township of Pennsylvania, in Mercer county, with 666 inhabitants.

WEST SOUTHWARK, a town of Pennsylvania, in the county of Philadelphia, containing 6443 inhabitants.

WEST SPRINGFIELD, a town of Maffachusets, in the county of Hampshire, containing 3169 inhabitants.

WEST STOCKBRIDGE, a town of Maffachusets, in the county of Berkshire, containing 1049 inhabitants.

WEST WHITELAND, a township of Pennsylvania, with 636 inhabitants.

WEST WINDSOR, a town of New Jersey, in the county of Middlesex, containing 1714 inhabitants.

WET AIR. See MOISTURE.

Wet Couch, a term used by the maltsters for one of the principal articles of malt-making.

In the making of malt, the usual way is to soak the grain in water two or three days, till it becomes plump and swelled, and the water is brown; the water is then drained away, and the barley is removed to a floor, where it is thrown into a wet couch, that is, an even heap of about two feet thick.

In this heap the barley spontaneously heats, and begins to grow, shooting out first the radicle, and, if suffered to continue growing, soon after the blade; but at the eruption of the radicle, the prococ is to be stopped short, by spreading the wet couch thin over the floor, and turning it once every four or five hours for two days, laying it thicker each time; after this it is thrown into a large heap, and there suffered to grow hot of itself, and afterwards spread abroad again and cooled, and then thrown upon the kiln to be dried crisp, without scorching. Shaw's Lectures, p. 186.

Wet Dock. See Dock.

Wet-Glover, a dresser of the skins of sheep, lambs, goats, &c. which are slender, thin, and gentle.

WEDA, or Windao, in Geography, a river of the duchy of Courland, which runs into the Baltic, a little below Windau.

WETERFELD, a town of Bavaria, on the Regen; 21 miles N.E. of Ratibon.

WETER-GETTER, among Sheep-Farmers. See RAM.

WETHER-SHEEP, in Rural Economy, a term applied by stock-farmers to a castrated male sheep of more than one year old; but before that time it is called a wether-lamb. The wethers of the improved breeds of sheep, espically those of the new Leicestter fort, are much more early than the old kinds. See SHEEP.

WETHERBY, in Geography, a market-town in the upper division of the wapentake of Claro, West Riding of the county of York, England, is situated on the river Wharfe, 7 miles N.W. from Tadcaster, about the same distance S.E. from Knaresborough, and 94 miles N.N.W. from London. The course of the river forms an angle, whose sides are each about one mile in length; at the point of this angle the town is seated. It affords nothing worthy of notice, but a handsome bridge crossing the Wharfe. Above this bridge the river forms a beautiful cascades, by falling.
falling in a sheet of water over a high dam erected for the convenience of the mills. Over this cascade, the salmon, in their way up the river from the sea, are seen to leap with wonderful dexterity. Wetherby has a weekly market on Thursdays, and three annual fairs. In the population return of the year 1811, the town is stated to contain 1140 inhabitants, occupying 454 houses. In the time of William the Conqueror, this town was possessed by two Norman lords, William de Percy and Ernse de Buron. It was afterwards given to the knights templars; and, together with all their estates in England, was forfeited on the abolition of their order, in the year 1312. In the civil war of Charles I, this town was Garrisoned by Sir Thomas Fairfax, who, in 1642, repulsed Sir Thomas Glenham, in two different attacks. A little below the town is St. Helen's Ford, where the Roman military way crossed the Wharfe. Within a mile of the town is Wetherby Grange, the seat of Richard Thompson, esq. In the park is an heronry, a thing rather uncommon in this part of the country. The herons build their nests in the tops of the highest trees; but seldom take the trouble, when they can get them ready made by the rooks, whom they expel, and enlarge and line the nests, driving away the original poiffessors, should they happen to renew their fruitless claims.

About two miles to the west of Wetherby, is Stockeld park, the seat of William Middleton, esq. His ancestors descended from Hylpomus de Brame, lord of Middleton, who lived in the reign of Henry II. Not far from the house, and near the high road, is a rock of a very singular shape, 65 feet in circumference, and 30 feet high, standing on the margin of a lake.—Hargrove's History of Knareborough, 1809. Beauties of England and Wales, vol. xvi. Yorkshire. By J. Bigland, 1812.

WETHERSFIELD, a town of Connecticut, in the county of Hartford, containing 3561 inhabitants.

WETMORE'S ISLAND, a small island on the coaft of Machias, at the mouth of the river Penobscot.

WETSTEIN, John James, in Biography, was born at Bafle in 1693, and made such proficiency in his early studies, that he was fit to be admitted into the university at the age of eleven years. In his 20th year he was ordained minifter, on which occasion he maintained a disputation on the various readings of the New Testament, in which he defended the authenticity and integrity of the text. To this course of study he was sedulously devoted, and in order to explain the words and pharases of the New Testament, he carefully read the Greek authors, both sacred and profane; and he also consulted the Rabbinical writings, for the purpose of acquainting himself with the opinions and cufoms of the Jews. Richly furnished with this kind of knowledge, he set out, in 1714, on a literary tour to Zurich, Berne, and Geneva. From the latter place he proceeded through Lyons to Paris, where he became acquainted with Montfaucon, Courayer, and other eminent men; and he also visited England, where he was particularly noticed by the celebrated Bentley, and diligently searched for MSS. of the New Testament. During his stay in this country, he was made chaplain to a regiment of Swifs troops, and having obtained leave of abifenee, visited Paris, in order to collate a particular MSS., and, after three months, joined the regiment at Bois-de-duc. Having afterwards visited Holland and Germany, he returned to Bafle in 1717, and became deacon to the church of St. Leonard, which office he held with distinguished approbation for nine years. In purfuance of his main object, he corresponded with Bentley on the subject of various readings; but he was interrupted in his plan by a violent dispute with a divine of Bafle, who had been his intimate friend, occasioned by his publication of a specimen of his various readings in 1718. In the progress of this dispute, the clergy took a part, and presented a petition to the council, requiring that Wetstein's edition of the New Testament might be prohibited; alleging, amongst other objections, that it favored Socinianism. His Prologena, however, were printed in 1730, and a new accusation was preferred to the council against the author. This kind of clamour proving ineffectual, his enemies engaged some of his pupils to appear as witnesses against him; and they produced extracts of his lectures from the MS. copies of these pupils to support their accusation. The result of these dishonourable proceedings was a suspension of his functions in 1729, and this was soon followed by his total deposition. This conduct of the clergy was aggravated by a variety of misrepresentations; the ministers of Mulhausen, Neufchatel, Vallangen, and Geneva, expressed their disapprobation of these measures; and forty heads of families in the parish of St. Leonard presented a petition for obtaining Wetstein's re-establishment. But as this interposition on his behalf was unsuccessful, he left his native country, and removed to Amsterdam, where the Remonstrants elected him professor of philosophy in the room of Le Clerc, requiring, at the same time, that he should justify himself, either by a public apology, or before the council at Bafle. Adopting the latter method, he returned to Switzerland, and in the presence of thirteen commissioners, chosen from the council and body of the professors, he swore that the extracts furnished by his pupils were not worthy of credit; that the witnesses had sworn nothing that could prove the accusation alleged against him; and that the acts of the divines contradicted each other. The council, in March 1733, annulled the decree of condemnation, and restored him to the full exercise of his functions. The Remonstrants at Amsterdam were satisfied, and in 1735 he took possession of his office, the duties of which he faithfully discharged till his death. His character being re-established at Bafle, he was elected in 1744 professor of the Greek language; but the Remonstrants, in order to retain him, nominated him professor of ecclesiastical history, and made an addition to his salary. Amidst the labours of the offices, which he sustained with great honour to himself and benefit to his pupils, he proceeded in collecting and arranging his various readings of the New Testament; grudging no expense, and availing himself of every opportunity that occurred in collating various MSS. Encouraged by a great number of learned men in England, Holland, and Germany, he at length published his first volume in 1751, and the second in the following year; and in order to preclude every objection, he printed the text from that commonly received, and the various readings at the bottom. To the whole he subjoined a commentary, comprehending all the remarks with which he had been furnished by the Hebrew, Greek, and Roman writers whom he had consulted. His attachment to received principles is evinced by his mode of explaining several passages, and particularly those which related to the divinity of Jesus Christ. To his New Testament he added two epistles of St. Clement, now first published, with a Latin version, and a dissertation on their authenticity. His literary reputation being now established, he was made a foreign associate of the Academy of Sciences at Berlin, in 1752; and in the following year elected a fellow of the Royal Society in London. Although Wetstein's constitution was vigorous, his incessant labour accelerated the infirmities of age; and he was seized with a numbness and coldness in his right leg, which threatened a gangrene, and all attempts to check the progress of this malady were ineffectual; so that it terminated his valuable life
in March 1754, in the 61st year of his age. He beheld the approaches of death with tranquillity and resignation. Wet-ten was social, and fond of innocent amusements, though studious. He was an excellent Greek scholar, possessed a retentive memory, and spoke several modern languages. He was affable even to strangers, and kind and condescending to his pupils. His benevolence comprehended all of every nation and communion, and he was prompt in communicating advice and counsel to all who applied to him. His character has been amply vindicated from invidious and degrading charges by Kriigout, in his "Memoria Wett-teniana Vindicata," 4to. Formey's Elog. Gen. Bio!. WETTLESHEIM, in Geography, a town of Germany, in the principality of Anspach; 4 miles N.W. of Treucht-lingen.

WETTENHAUSEN, a princely abbey, founded in the tenth century; 20 miles W. of Augsburg.

WETTER, a town of Germany, in the county of Mark; 6 miles S.W. of Schwert. — Alto, a town of Germany, in the principality of Hesse; 6 miles N.W. of Marburg. N. lat. 50° 54'. E. long. 8° 45'. — Alto, a river of Germany, which rises in the county of Solms, and runs into the Nidda, at Afehnheim.

Wetter Island, an island in the East Indian sea, about 90 miles in circumference, of an irregular form. S. lat. 7° 24'. E. long. 126° 45'.

Wetter Lake, a lake of Sweden, in East Gothland, sixty-five miles long, and from ten to sixteen wide. This lake has but one outlet by the river Motals, though above forty little streams discharge themselves into it. This lake lies much higher than either the Baltic or the North sea, and is deep and clear, but very boisterous in winter. It is supposed certainly to prognosticate the approach of stormy weather. As this lake, like all inland pieces of water, surrounded with hills or mountains, is subject to sudden storms in the slightest weather, superabundance and credulity cooperating, in other cases, have been busy in explaining and attributing causes for this phenomenon; and accordingly it has been reported and credited, that these sudden storms are occasioned by a subterraneous communication with the lake of Constance in Switzerland. It is said, that by a regular series of correspondence and observation it was found, that when the waters of one lake arise, those of the other fell in the same proportion; and frequently the waters of the Wetter were violently agitated without the least wind, or any apparent cause, until information arrived that at the same time the lake of Constance had been disturbed by a tempest. The whole is supposed to be a fable grounded on some antiquated tradition. See WADSTENA.

WETTERAU, or Wetteravia, a country of Germany, bounded between the county of Hesse and the river Maine, which takes its name from the river Wetter. It contains the counties of Siegen, Schaumburg, Dillenburg, Dietz, Hadamar, Weilburg, Idstein, Hanau, Solms, Wetterburg, Ilmenburg, Sayn, Witgenstein, Hohenbeil, Cronberg, and Walemburg, the lordships of Weid, and the imperial towns of Wetzlar, Friedberg, and Gelhausen. The northern part is called Weflerwald.

WETTERINGEN, a town of Germany, in the bishopric of Munster; 7 miles S.W. of Rheine.

WETTING, a town of Weithphalia, in the duchy of Magdeburg, on the Saal, the principal place of a bailiwick, which was formerly a county, in the year 1283 granted to the cathedral of Magdeburg. In the neighbourhood are some coal-mines; 34 miles S. of Magdeburg. N. lat. 51° 37'. E. long. 12° 5'.

WETTINGEN, a town of Switzerland, and principal place of a bailiwick, in the county of Baden, on the Limmat, with a celebrated wooden bridge of one arch over the river, executed by the same person who built the bridge over the Rhine, at Schaffhausen; 1 mile S. of Baden.

WETZ, a river of Germany, which runs into the Lahn, near Wetzlar.—Alto, a town of Germany, in the principality of Solms Braunsfeld; 5 miles S. of Wetzlar.

WETZLAR, an imperial town of Germany, in the circle of the Upper Rhine, situated on the Lahn. The Roman Catholics, the Lutherans, and the Calvinists, have each a church; 45 miles E. of Coblenz. N. lat. 50° 34'. E. long. 8° 33'.

WEWELENSBURG, a town and citadel of Weithphalia, in the bishopric of Paderborn; 8 miles S. of Paderborn.

WEVER, a river of England, in the county of Chester, which runs into the Dee, 7 miles N. of Chester. — Alto, a river of England, in the county of Devon, which runs into the Culm, near Bradninch.

WEWERHAM, a township of England, in Cheshire; 3 miles W. of Northwich.

WEWERY, a river of Wales, which runs into the Wye, near Builth.

WEWER, or WEVER, a town of Weithphalia, in the bishopric of Paderborn; 22 miles S.S. W. of Paderborn.

WEWURZE, a river of Lithuania, which runs into the Minnic, 3 miles S. of Proccus.

WEXEL, a mountain of Stiria; 4 miles N.W. of Friedberg.

WEXFORD, a county of Ireland, in the south-east part of it, which has St. George's Channel on the E. and S., the counties of Waterford, Kilkenny, and Carlow, on the W., and that of Wicklow on the N. It extends from N. to S. 44 Irish miles, and from E. to W. 25; being 56 English miles in length, by 32 in breadth. It contains 342,900 acres, or 535 square miles Irish, equal to 550,888 acres, or 605 square miles in English measure. The number of parishes 142, having 41 churches, all of which, except two parishes with one church, are in the diocese of Ferns. The population was estimated by Dr. Beaufort at about 115,000. Wexford forms almost a peninsula, being separated from Waterford and Kilkenny by the haven of Waterford, and the deep and navigable river Barrow, and from the counties of Carlow and Wicklow by formidable ranges of mountains, which admit of few pannes. Being situated next to the principality of Wales, and nearly opposite to the mouth of the British Channel, it presented great advantages to the English invaders of Ireland in the reign of Henry II., who, after their first victories over the natives, selected this county, from its natural strength, for the residence of the first colonists. The inhabitants of the baronies of Bargin and Forth are supposed to retain traces of their descent from these settlers. (See BARGIE.) Wexford cannot be called hilly or mountainous, except on the frontiers of Carlow and Wicklow. Yet it contains a great deal of coarse cold land, and stiff clay soil, which, with the lime-borne renders it difficult and expensive to improve. The baronies of Bargie and Forth, being of a lighter soil, are well tilled, and produce large quantities of barley. The river Slaney crosses the county from Newtown Barry to Wexford, receiving the Barron from the northward, and affords a perpetual variety of picturesque and romantic views among its wooded and winding banks. This river is navigable to Emmicorothy. The linen manufacture has made no progress in this county, but there is a manufacture of coarse woollens. The chief towns are Wex- ford, New Rofs, and Emmicorothy, of which an account is given.
given under their names. Wexford has been notorious for
the events which took place in it during the rebellion
of 1798. In it the misguided populace was successful
for some time, and the massacres at Scullabogue; and at
the bridge of Wexford, afford a melancholy proof of what
may be expected from an ignorant and almost barbarous pea-
tantry, when they have the ascendency. Their leaders were
unable to control them, and if the king’s troops had not
been successful, there would have been no bounds to their
exterminating phrenzy. Before the Union, Wexford had
eighteen members, but these have been reduced to four, two
for the county, and one each for the towns of Wexford and

WEXFORD, a sea-port and post-town, and also the affize
town of the county of the same name, in Ireland, at the
mouth of the river Slaney. It was originally built by
the Danes, who named it Wexford, and it was formerly con-
dered a place of strength, being enclosed by very thick
walls, some of which are still remaining. There are some
handsome buildings; on the site of the old castle the bar-
acks are erected, commanding an extensive view of the
harbour. The church, situated in the main street, is an
elegant modern structure. The market and court-house are like-
wise new edifices; but the chief ornament of Wexford is its
wooden bridge, thrown over an arm of the sea, 2100
feet long, when an infurmountable difficulty baffled all
efforts to form a stone bridge. This bridge is a favourite
promenade, and is as delightfully calculated for a pleasant
recreation, as it constitutes an useful communication. The
harbour, though spacious, is shallow, and formed by two
necks of land, between which there is an entrance about
half a mile broad, which was formerly defended by two
ports, erected at the extremity of each illus. The
mouth of the harbour is choked with a bar, and there-
fore no vessel drawing more than twelve feet water can
pass to the town. Provisions of all kinds are very plentiful
and cheap here, particularly the finest wild fowl. The chief ex-
port is corn, principally barley and malt. Wexford was
taken from the Danes by the English invaders, after a siege
of four days, in 1170; it was besieged and stormed by
Cromwell in 1649; and on being evacuated by the king’s
troops, it was taken possession of by the rebels in 1798.
The shocking murder of the loyal inhabitants, when 97 un-
offending victims suffered at the bridge, has been already
alluded to. There are seven parishes, but they are all
united, and have only one church in common. Wexford is
67 miles S. by W. from Dublin. Carlyle. Traveller’s
Guide.

WEXIO, a town of Sweden, in the province of Smal-
land, situated on the Helga lake: the site of a bishop, and
residence of the provincial governor; 46 miles N.N.W. of
Carlsbora. N. lat. 56° 22'. E. long. 14° 44'.

WEY, a river of England, which runs into the Thames
at Weybridge. This river is navigable to Guildford and
Godalming, and a canal has lately been made from it to
Basingtloke, in Hampshire.—Allo, a river of England,
which runs into the sea at Weymouth. 

WEY. See WEIG.

WEYBER, in Geography, a lake of Bavaria; 3 miles
W.N. of Konpien.

WEYBRIDGE, a considerable village in the hundred
of Elmbridge, and county of Surrey, England, is situated
on the river Wey, whence it derives its name, not far from
its confluence with the Thames, at the distance of 12 miles
N.E. by N. from Guildford, and 20 miles S.W. by W.
from London. It contains some respectable houses, among
which is a large edifice, called Holteim-house, from having
been the residence of a prince of Holstein, when on a visit
to England; it has for some years been used as a printing-
office. The church is a small, but neat structure, having a
cape and south aisle, at the west end of which is the vault
of the earl of Portmore’s family, built up about four feet
above the level of the pavement, inclosed with iron rails,
but without any inscription. The population return of the
year 1811 states the parish of Weybridge to contain 167
houses, and 918 inhabitants.

In this parish is Oatlands, the seat of his royal highness
the duke of York. This domain came into the possession
of Henry VIII. by an exchange with the family of Rede,
for the manor of Tandridge, in the same county. It was
settled by Charles I. on his queen Henrietta Maria for her
life; and their youngest son, called Henry of Oatlands, was
born here. At the Restoration the queen dowager was
again put into possession of the estate; and after her death
Charles II. granted it to the earl of St. Alban’s. In the
next century it descended to the earl of Lincoln, after-
wards duke of Newcastle, who fixed his residence here,
and enlarged the park, and made considerable plantations. In
the park is a large piece of water, formed by springs which rise
in it. Between the house and garden is a grotto, divided
into three apartments, in one of which is a bath, supplied
by a small spring, dripping through the rock; at the end of
it is a copy of the Venus de Medicis, as if going to bathe.

The duke of York purchased this estate of the duke of
Newcastle, together with the manors and parks of Byfleet
and Weybridge, which he held by leases from the crown.
In 1800 two acts were passed for inclosing the common fields
and waste, under which the duke obtained by allotments
and purchases about 1000 acres of the waste, so that the
domain now comprises about 3000 acres. The mansion
was burned down while the duke was in Flanders, in 1793.
The present house was then erected, from designs by Mr.
John Carter; and in 1843 an act was passed for granting to
the duke so much of this estate as was held of the crown.

In a small park on this elevation is Hartham, an old manion,
formerly the residence of the counts of Dorchelter, mi-
trefles of James II. It is now uninhabited, and in a ruinous
condition. Near it are many large cedars; one, in particu-
lar, measures, at five feet from the ground, about thirteen
feet in circumference, and runs up straight to a great height.

—History and Antiquities of Surrey. By the Rev.
John Manning, and William Bray, eqq. 3 vols. folio.
Shoberl.

WEYBRIDGE, a township of the hundred of Vermont, in
the county of Addison, separated from New Haven by the Otter
Creek, containing 750 inhabitants.

WEYDA, a town of Saxony, in the circle of Neulaut,
the Elster; 11 miles E.N.E. of Neulaut. N. lat. 50°
42'. E. long. 12° 11'.—Allo, a river of Saxony, which
runs into the Elster, 2 miles N. of Weyda.

WEYDEN. See WEDEN.

WEYDENAU, a town of Schleis, in the principality of
Neiße; 8 miles S.W. of Neiße. N. lat. 50° 12'. E.
long. 17° 1'.

WEYDENEN, a town of Prussian Lithuania; 3 miles
W.S.W. of Pulkallen.

WEYDENHAYN, a town of Saxony, in the margra-
vate of Meissen; 7 miles W. of Torgau.

WEYER, a town of Austria; 2 miles N.E. of Grun-
den.—Allo, a town of the duchy of Sturia; 6 miles S. of
Pruck.

WEYEREN, a town of Austria; 6 miles W. of
Gmunden.
W E Y

WEYERS, a town of Westphalia, in the bishopric of Fulda; 8 miles E.S.E. of Fulda.

WEYERSHEIM, a town of France, in the department of the Lower Rhine; 6 miles S. of Haguenau.

WEYHER, a town of Austria; 6 miles W. of Bavarian Waldhoven.

WEYHILL, a village of England, in the county of Hants, celebrated for the great annual fair held here for the sale of sheep, hops, &c.; 3 miles W. of Andover.

WEYL, or Wyl, a town of Switzerland, belonging to the abbey of St. Gal, and principal place of a bailiwick; 14 miles S.S.W. of Constance.

WEYLANOOG, a town of Hindoostan, in Guzerat, on the coast; 20 miles S.E. of Putton Summit.

WEYMOUTH, or Weymouth, a borough and market-town in the hundred of Uggecombe, Dorchester division of the county of Dorset, England, is situated on the southern coast of England, at the extremity of a beautiful bay, which forms nearly a semicircle, making a sweep of about two miles. The town is 8 miles S. by W. distant from Dorchester, and 128 miles S.W. by W. from London. It received its name from the mouth of the little river Wey, near which it stands, and communicates with Melcombe Regis, to which it is united by a bridge erected in 1770. That the site of Weymouth was known to the Romans is probable from several circumstances; and Mr. Baxter supposes it to have been the Clavunio, which is mentioned in the anonymous Ravennas. In the Saxon ages, however, it is expressly named in a Saxon charter still extant, by which king Ethelred gave a certain portion of land, called by the inhabitants Weymouth (or Wick), near the site of Portland, to his faithful minister Atleare. In the reign of Edward III. the town had become of some importance, the inhabitants being ordered, together with those of Melcombe and Lyme, to send a certain quota of ships for the king’s expedition to Gascony. In the 21st year of that reign, Weymouth (for Melcombe is not mentioned, though perhaps included) furnished the king with 20 ships, and 264 mariners, at the siege of Calais, according to the roll of his fleet preserved in a manuscript in the Cottonian Library. In the year 1471, Margaret of Anjou, with her son, prince Edward, landed here from France, in order to restore her husband to the throne. In 1507, king Philip of Castile, with his queen, were driven on this coast, and having run into the port, were detained by sir Thomas Trenchard, till an interview took place between the English and Spanish monarchs, from which the former derived some advantages. In 1588, Weymouth contributed six ships to oppose the Armada, one of which was of 120 tons burthen. During the civil war of Charles I., this town was alternately garrisoned and besieged by the king, and by the parliament’s forces. In 1649 the corporation petitioned parliament for an indemnification for the losses they had sustained in the war, and a relief from the burthen of maintaining the garrison; but their request does not appear to have been granted, as a letter was soon afterwards received containing the “refractoriness of the magistrates.” The manors of Portland and Wike, with the ports of Waimouth and Melcombe, and the liberties attached to them, were granted by charter of Henry I. to the monks of St. Swithun, Winton; and Henry II. confirmed the port of Waimouth and the whole land of Melcombe to that establishment, with additional privileges. Weymouth and Melcombe are (as has been observed under Melcombe Regis) too frequently joined in defecits and ancient grants, that some difficulty occurs in separating them with precision. Weymouth is the more ancient borough; though neither sent members to parlia-

ment till the reign of Edward II., since which time each of them returned two. Melcombe, being part of the demeine of the crown, and possessing some peculiar privileges, is principally noticed in succeeding charters. The rivalry which subsisted for centuries between the two boroughs arose, in the reign of Elizabeth, to such a height, that it was judged expedient to unite them; and an act was passed in her 13th year (afterwards confirmed by James I.), by which they were incorporated, and directed hereafter to be called “The united Town and Borough of Weymouth and Melcombe Regis,” the government being vested in a mayor, recorder, two bailiffs, an indefinite number of aldermen, and twenty-four capital burgesses; and they now poll, as one borough, the peculiar right, with the metropolis, of electing four members to parliament. The representatives are elected by the freeholders of Weymouth or Melcombe, whether inhabitants or otherwise. The number of voters is about two hundred. These electors have also votes for the county members. Leland says, “The toment of Weymouth lyeth far from Milton (Melcombe) on the other side of the haven, and at this place the water of the haven is but a small brede, and the trougus is by a bote or a rope bent over the haven; so that in the ferry-bote they use no oars. Waigmouth has certain liberties and privileges, but there is no mair in it. Thar is a kay and wharf for hipples. By this town on a hill is a chapel of ease. The paroch church is a mill off.” The chapel mentioned by Leland was remarkable for its elevated situation; having, according to Coker’s survey of this county, an ascent of eighty stone steps. It was of considerable antiquity, as appears by a patent of Henry VI., granting a licence to found a guild in the chapel of St. Nicholas, in the borough of Weymouth, by the name of the master and wardens of the fraternity or guild of St. George, in Weymouth. This chapel was demolished in the civil war; the site is still called Chapel Hays, and is now used as a bowling-green. Weymouth, since the time of Elizabeth, had, from a variety of causes, been gradually going to decay. The removal of the wool-rotaple to Poole, the loss of the Newfoundland trade, the havoc made by the civil wars, damages by fire, want of public spirit, and other circumstances, had conduced to produce this effect; and till it began to acquire celebrity as a watering place, it was little more than an unconsiderable fishing-town. The late Ralph Allen, Esq. of Bath, about the year 1763, first contributed to bring Weymouth into repute. Having received great benefit from bathing there, he proclaimed its salubrity to the extensive circle of his acquaintance; and his encomium being exceeded by the real beauties of the situation, it soon began to be the resort of the first company from all parts of the kingdom. The reputation thus acquired was extended by the late duke of Gloucester, who, having derived considerable advantage himself, provided a residence for the accommodation of the royal family; and their majesties, accompanied by the three elder princes, in the year 1789, made their first visit to this place. His majesty experienced its beneficial effects, and became so attached to the spot, that he has repeatedly honoured it with his presence. The advantages arising from these visits have proved of the greatest consequence to the town, which has rapidly augmented in size and importance, from the vast concourse of people by which it is now frequented. The chief objects of curiosity to strangers, are the Esplanade and the Bay. The Esplanade, a fine level piece of land, which, but a short time ago, was nothing but a receptacle for all the rubbish of the town, is now converted into one of the most charming promenades in England, and adorned by a range of handsome edifices. This
WHALE, in Astronomy, one of the constellations. See CETUS.

WHALE, Cetus, in the Linnaean system of Zoology, the seventh in the class of mammals. For the characters and distribution of this order, see CETUS.

For the discriminating characters of the genus balana, or whale, and a general account of its species, see BALANA.

The common whale, or balana mysticetus of Linnaeus, with its variations, &c., is described under the article MYSTICETUS. Aristotle is said to have given it the name of mysticetus, poroicus, or bearded whale, from its having in its mouth hairs instead of teeth.

In old time the whale seems never to have been taken on our coasts, but when it was accidentally flung on shore: it was then deemed a royal fish; and the king and queen divided the spoil; the king affixing his right to the head, and the queen to the tail. The reason of this whimsical division, as ascribed by our ancient records, was to furnish the queen's wardrobe with whale-bone.

The anatomy of the bones of the whale has been so little understood, that there have been many very great errors in regard to such of them as have been at times found fossil, or buried in the earth among the teeth of elephants, and the remains of tetracous and other animals. The most frequent and most ridiculous of all the wrong opinions about these, is their having originally belonged to creatures of the human species; yet many, even among the more intelligent part of the world, have taken them for the remains of giants. The vertebræ of a whale have been mistaken for those of a giant, and a part of its fins for a hand, and fo of the rest. While the world, more ready to spread the marvelous, than to enquire into the truth, have made computations of the height of the man to whom bones of that size must have belonged, and from their proportion in regard to those of the common human size, have found the giant who possessed them must have been 90 or 100 feet high; much less pains in comparative anatomy would have taught them, that they never could have belonged to any human body at all. Mem. Acad. Par. 1727.

WHALE, Beaked, Bottle-head, or Noble-haul, Balana Reftrata, the small whale, with taper finout, and adiopoe back fin, or with very long and acute beak or finout. The head, upper part of the back, fins, and tail, are of a dark or blueish-brown; and the sides and abdomen are of a beautiful white, with a flight tinge of pale rofe or fleth colour; and marked for more than half the length of the animal by numerous longitudinal plaits or furrows: the eyes are small, as is also the head, and the finout is more elongated than in any other species, tapering gradually to the extremity, which is slightly pointed; the back fin is small, and situated at no great distance from the tail; the pectoral fins are small and narrow, and the tail is divided into two long and pointed lobes. This is of a more elegant form than that of the larger species. These fish sometimes, but rarely, grow to the length of twenty-five feet; they make little noise in blowing, are very tame, come very near the ships, and will accompany them a great way.

WHALE, Fin-back, Balana Phyalus of Linnaeus, called also fin-fish. See PHYSALUS.

WHALE, Pike-headed, Balana Boops of Linnaeus, is a species which takes its name from the shape of its nose, which is narrower and sharper-pointed than that of other whales. The length of one taken on the coast of Scotland, observed by Sir Robert Sibbald, was forty-six feet, and its greatest circumference twenty; but it sometimes exceeds this length. From the skinny flap at the root of the tongue, as well as from
from the intellines, the Greenlanders prepare windows. See Boops.

**Whale, Round-lipped, or Broad-nosed, or Under-jawed, Balena Musculus of Linnaeus**, is characterized by having the lower lip broader than the upper, and of a semicircular form. See Musculus.

**Whale, Bunchef, Balena Gibbosa of Linnaeus, with one or more gibbous excrescences on the back, and without dorsal fins:** the knoefelfich oder knobbelfich of Anderfon and Crantz. This species is a native of the Northern seas, and though not much known, is said to be of the same general form with the great whale, but of smaller size, and having its back furnished with one or more tubercles. The variety with a single tubercle is found about the coasts of New England; the other with fix tubercles along the back is supposed to swarm about the coasts of Greenland. Their whale-bone is said to be of a pale or whitlil colour.

**Whale Spermaceti.** See Cachalot, Physeter, and Spermaceti.


**Whale-Blubber, in Agriculture,** the fat oily refuse matter left in making the oil from that fish. It is a material which has been used as a manure in some cafes with succes, especially when employed in mixture with clayey loam, sandy loam, or any other common earthy or mouldy substanences. These matters should be blended together in such a manner, it is said by the writer of the "Elements of Agricultural Chemistry," as to expose a large surface to the action of the air, the oxygen of which produces soluble matter from them. It is observed, too, that lord Somerville made use of this oily substanence with great successe on his farm, in the county of Surrey, in which cafe it was made into a large heap with foil, and retained its powers of fertilizing for several successive years.

It is noticed, that carbon and hydrogen abounding so much in this as well as other oily substanences, fully account for their effects; and that their durability is easily explained from the very gradual manner in which they change by the action of the air and water on them, as must obviously be the case.

This fatty material, in this sort of union with earthy matters, may confequently be a very benefical application in many cafes of tillage-land, especially where the superfical bed of mould or foil is rather of the thin kind. It may also be very useful as a top-dressing to grasfs-land, particularly where the fward is thin, tender, and not well fet with grassy herbage, as tending not only to promote the growth of the crops, but the clofemens and firmnes of the surface fwardy covering. See Manure, and Oil Compofit.

It should therefore be prefered and procured as much as poiffible for thefe uses and applications.

**Whale-Bone**, a commodity procured from the whiskers of the whale, used as a stiffening in flays, fans, bulks, fereens, &c. See Whale Spermaceti. Frederick Martens particularly described the whale-bone and the method of procuring it in his "Voyage to Spitsbergen." Within the mouth of the fish is the whale-bone, hairy as a horfe's hair, and hanging down from both fides, all about his tongue. In some whales the whale-bone is bent like a fcymitar, and in others like a half-moon. The smallest whale-bone is before in his mouth, and behind towards his throat; and the middeft is the largest and the longest, being sometimes about two or three men's length. On one side, all in a row, there are 250 pieces of whale-bone, and as many on the other, containing in all 500; and there are still many more, for the cutters let the leaft of all remain, because they cannot easily come at it to cut it out, on account of the meeting of the two lips, where the space is very narrow. The whale-bone is in a flat row, one piece by the other, somewhat bending within, and towards the lips every where like a half-moon. It is broad at the top, where it flicks flat to the upper lip, every where overgrown with hard white finews towards the root, so that between two pieces of whale-bone you may put your hand. These white finews are of an agreeable smell, break very easily, and may be boiled and eaten. Where the whale-bone is the broadeft, as underneath by the root, there growth small whale-bone, the other being greater. The small whale-bone, as Mr. Martens supposes, does not grow bigger; for one end to the other it is equally thick, and full of logs, like horfe's hair. The whale-bone is underneath narrow and pointed, and all overgrown with hair, that it may not hurt that which is young; but without the whale-bone has a cavity, for it is turned like a gutter, in which the water runs, where it lies the one over the other, like the shields or plates of cray-fish, or the pantiles of an houfe, that lie one over the other; for otherwife it might easily wound or hurt the under lip. To cut the whale-bone out is a particular operation, and many iron tools are used for this purpose. Some whale-bone is of a brown, black, or yellow colour, with streaks of several colours. The whale-bones of some whales are blue and light-blue, which latter are fuppofed to come from young whales.

**Whale-Fins,** a name improperly given to whale-bone.

**Whale-Fijbery.** See Fishery.

**Whale-Oil.** See Oil.

Mr. Parkes (Effays, vol. i.) observes, that the dealer in Greenland whale-oil might allo increase the profits of his trade very much, by preparing his oil for sale when the weather is fuitable for the operation. This kind of oil is always purified by paffing it through large flannel bags, which retain the impurities, and suffer the finer parts to percolate through them. When the oil has undergone this treatment, it is called bagged oil, and is then deemed fit for sale. At a low temperature, a coniderable quantity even of this latter kind would concrete, and might be separated by simular means; whereas in a warm atmosphere this diffolves, and, being left inflammable, very much injures the oil for burning.

By proper attention to this circumstance, all the oil which is designed for burning might be very much improved, and the portion thus separated from it, would be worth more to the loaf manufacturer for making yellow loaf, than simular oil which had not undergone this process.

This intelligent chemist conceives, that an oil-merchant would do well always to bag different oils in different feasons; though many experiments might be neccessary before it could be ascertained what was the exact temperature at which the respective kinds would melt copiously depoit this feculence. After obseving that in feveral parts of Germany, and particularly in the neighbourhood of Gottenburgh, ammonia is prepared from the dregs which remain after the expreffion of train-oil, he fuggesfs that whale-blubber might be employed for the diffillation of ammonia. Madder, he fays, might be defived for correcting its offensive smell, and render-
WHA

Whale Fish Island, an island on the coast of Guiana, at the mouth of the river Efficbobo.

Whale Island, a small island in the north sea. N. lat. 69° 14'. W. long. 134°.—Also, a small island near the north-west coast of Borneo. N. lat. 4° 10'. E. long. 112° 21'.

Whale Islands, small islands in Portmouth harbour. N. lat. 50° 48'. W. long. 1° 5'.

Whale Point, the south-east cape of an island in the straits of Magellan; 6 miles S.S.W. of Paffage Point.

Whale Rock, an under-water rock at the entrance of the Bay of Islands, on which the Endeavour struck in 1769; 4 miles S.E. of Point Pocock.

Whale Sound, a channel in the straits of Magellan, between an island and the coast of Terra del Fuego.

Whalifirth Voe, a bay on the west coast of the island of Yell. N. lat. 60° 58'. W. long. 1° 25'.

Whame, in Natural History, the name given by the people of some parts of England to the barrel-fly, or wringle-tail, a species of bee-fly very troublesome to hones.

Whang-Ho, in Geography. See Hoang-Ho.

Whaplole, a township of Lincolnshire; 2 miles S. of Holbeach.

Whapping's Creek. See Wapping's Creek.

Wharf, a perpendicular building of wood or stone, raised on the shore of a road or harbour, for the convenience of landing or discharging a vessel, by means of cranes, tackles, capstans, &c. See Artificial Ports.

The fee paid for the landing of goods on a wharf, or for shipping them off, is called subarbage. And the person who has the oversight or direction of the wharf, receives wharfage, &c. is called the wharfinger.

There are two legal denominations of wharfs, viz. legal quays and suffereance wharfs.

Legal quays are certain wharfs in all sea-ports, at which all goods are required, by the 1 Eliz. c. 11., to be landed and shipped (except at Hull); and they were set out for that purpose by commissio by the court of exchequer, in the reign of Charles II., and subsequent princes. Others have been legalized by act of parliament; as the London docks, by 39 & 40 Geo. III. c. 47.; West India docks, by 39 & 40 Geo. III. c. 69. and 42 Geo. III. c. 113.; East India docks, by 43 Geo. III. c. 126. and 46 Geo. III. c. 113. (See Docks.) Hull, by 14 Geo. III. c. 56. and 11 Geo. III. c. 197.; Milford, by 50 Geo. III. c. 155.; Bristol, by 48 Geo. III. c. 71.

In some ports, certain wharfs are deemed to be legal quays by immemorial practice, though not set out by commission, or legalized by act of parliament; such as Chepflow, Gloucester, &c.

Suffereance wharfs are places where certain goods may be landed and shipped; such as hemp, flax, raff, and other bulky goods; likewise goods carried coakwise, in Great Britain, by special suffereance granted by the crown for that purpose.

The constituting limits to the ports and legal quays is part of the royal prerogative. Lord Hale's Treatise. Vide Harbrace's Traicts.

Wharf also, in a canal, denotes that wider part of it where boats lie while loading or unloading.

Wharfage, in Commerce, certain rates paid for landing and shipping goods from the quays.

Wharfe, or Wharf, in Geography, a river of England, in the county of York, which runs into the Oule, 7 miles below York.

Wharfinger, the proprietor or farmer of the quays where goods are shipped and landed.

Vol. XXXVIII.

By the 26 Geo. III. c. 40. no goods entitled to drawback or bounty on exportation are to be shipped in Great Britain, but by wharffers licensed by the commissioners of the customs, and in docked lighters. And they are to give bonds not to be concerned in illegally landing, relanding, or shipping goods. They are also liable to certain penalties at contriving or knowing of any fraudulent transfaftion, or landing goods at improper places and times, by 1 Eliz. c. 11., and 13 & 14 Cha. II. c. 11.

Wharton, Henry, in Biography, an English divine of the Established Church, was born in 1664, at Worsfold, in Norfolk, where his father was vicar; and in his sixteenth year admitted a pensioner of Gonville and Caius college at Cambridge, where he assiduously pursued the study of various branches of literature, and particularly of mathematics, under Ifac Newton, Lucasian professor. After taking the degree of B.A. with great reputation, he assisted Dr. Cave in his "History Literaria," contributing almost the whole of the appendix of the three last centuries. In 1689 he took orders, and his degree of M.A. in the following year. He had various literary occupations, chiefly in writing or editing treatises against Popy; until he left priest's orders, when he was presented first to the vicarage of Minter in the isle of Thanet, and in 1689 to the rectory of Chantham. By the advice of Dr. Lloyd, bishop of St. Asaph, he undertook the work which gave some celebrity to his name, intitled "Anglia Sacra, five Collectio Historiarum, partim antiquus, partim recentior. Scriptarum, de Archiepiscopis et Episcopis Anglie a prima Fide Christiana fucceptione ad Annus 1540," 2 vols. fol. London, 1691. An additional part was published after his death in 1695, under the title of "Hisoria de Episcopis et Decanis Londinensibus; neunon de Episcopis et Decanis Alavesibus (St. Asaph); a prima Sedis ururinque Fundatione ad Annus 1540," 8vo. The author's "Anglia Sacra" was the refult of great industriy and labour, and evinces the author's zeal for the church to which he belonged; but it is chargeable with incorrectnec.

In 1692 he published "A Defence of Pluralities;" in the following year he edited some ancient theological pieces; and, under the name of Anthony Harmer, published "A Specimen of some Errors and Defects in the History of the Reformation of the Church of England, by Gilbert Burnet, D.D.;" a work which excited the indignation of the author, and caused him to mention Wharton with afperity in the introduction to the third volume of that work. The last publication of Wharton was "The History of the Troubles and Trial of Archbishop Land;" to which were added Land's diary, and some other pieces. He also edited the Life of Cardinal Pole, by Bacatelli, together with some animadversions on Strype's Memorials of Archbishop Cranmer. Although his constitution was strong, he closed his life, in consequence of intense application, some time prematurely, in March 1694-5, in the 31st year of his age, leaving several MSS., some of which were afterwards printed, as also two volumes of sermons. He was interred in Westminster-Abbey. Biog. Brit.

Wharton, Philip, Duke of, the son of the marquis of Wharton, who was a firm supporter of the Revolution and Hanover succession, was born in 1699; and after having exhibited talents which commanded notice, when he was 13 or 14 years of age, in the course of his education under domestic tutors, contracted a premature marriage with the daughter of major-general Holmes, and thus disappointed his father's views, and hastened his death in 1715.

In the beginning of 1716, Philip set out on his travels, proposing to finish his education at Geneva; but the young marquis, having contracted a taste for gaiety and experence, was
was disguised with the manners of that place, and leaving his governor there, proceeded to Lyons, and wrote to the Pretender at Avignon, accompanying his letter with the present of a fine horse. The Pretender was highly gratified, and receiving the marquis at his court, decorated him with the title of the duke of Northumberland. At Paris he paid his respects to the dowager-queen of James II., and received notice and good advice from the English ambassador, lord Stair. About the end of 1716 he returned to England, and going over to Ireland, where he pollied to a peerage, he was admitted to take his seat in the house of lords of that kingdom. Here, defying the principles and connection which he had lately formed, he defended the established government with all the powers of his reasoning and eloquence; in consequence of which he was advanced to a dukedom, by the style of duke of Wharton, in the county of Westmoreland. Upon coming to age, he took his seat in the English house of lords, where he distinguished himself by an abandonment of his lately avowed principles, in the defence of bishop Atterbury; and he also published a virulent opposition paper, intitled "The True Briton." But such was his boundless extravagance, that his estate was vested, by a decree of chancery, in the hands of trustees, who allowed him an annuity of £200. Having only this pittance, he determined to live abroad, and to enter into the service of the Pretender. Having visited Vienna and Madrid, he formed an acquaintance at the latter place with a young lady of Irish extraction, who was maid of honour to the queen of Spain, and married her; his duchess having died in 1726, without leaving any issue. From Rome, where he appeared under the title of the duke of Northumberland, and decorated with a blue ribbon and garter, he returned to Spain, and obtained permission from the king to go as a volunteer to Gibraltar, which was then under siege by the Spaniards. When this siege broke up, he visited the Spanish court, and was nominated by the king "colonel-aggregate" of one of the Irish regiments. Discouraged in his wishes to be actively employed in the service of the Pretender, he went to Paris, and with singular effrontery paid a public visit to the English ambassador, Horace Walpole; informing him, upon taking leave, that he was going to dine with the bishop of Rochester, though it had been made criminal to hold any communication with that exiled person. At this time a bill of indictment for high treason was preferred against him in England, for having appeared in arms against his majesty's forces at Gibraltar; but a wish to reclaim him induced Sir Robert Walpole to lend two friends to offer him his re-establishment and the possession of his estate, if he would only sue for pardon. This he refused to do, contenting only to accept a pardon if freely granted him. His allowance from Rome was discontinued, and he was overwhelmed with debts abroad. From Rouen, where he had for some time resided, he removed to Paris, living meanly, and providing for himself by various dishonourable expedients. Having obtained a small sum, when all his resources had failed, he took his duchess with him, and went by water to Bilboa. From thence he proceeded to join his regiment, subjecting his duchess to extreme distress, in which state she was occasionally relieved by the bounty of the duke of Ormonde, who was himself an exile. In 1730 his health declined, and he amused himself in composing a tragedy, on the story of Mary queen of Scots; but his end was approaching. In his way to a mineral spring, in the mountains of Catalonia, where he had once obtained relief, he was obliged to stop at a small village, when his condition was so pitiable to ultimate, that the fathers of a Bernardine convent took compassion upon him, and brought him to their house, where by atten-}

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perfectly resembled grains of wheat, and which on being sown in a garden very unexpectedly proved to be wheat of the spring kind, and the usual size, the grains of which being nearly, if not wholly, as large as those of the ordinary wheat of the above fort, that the packet and seeds came either from the peninsula, or from the hilly country, far within land from Bengal, as that province itself is a flat alluvial tract of land, entirely level. That as this hill wheat is, however, no doubt, it is supposed, known to some persons who are now either in India, or who have lately returned from thence into this country, it is certainly a matter of some importance to know what information they can give on the subject of it, especially whether this wheat be a cultivated, or a wild plant; as we shall, it is said, if the latter be the case, ascertain two of the greatest desiderata of cultivators; as those of the country where wheat grows spontaneously, and the nature of the grain in its original state, when unassisted by the sowing hand of man.

It is by no means improbable, from the nature and habits of wheat, that it may have come originally from the hilly country of the east, and been rendered hardy by time and cultivation in this and most other parts of the world.

Wheat is a kind of grain of which there are two different species, in cultivation as crops, in the climate of this country; as the common smooth or polished wheat, and the cone rough or bearded wheat. Of the first of these forms, which is by much the most cultivated in this kingdom, as being the most suited to the nature and quality of the largest part of the soils or lands in it, and as affording the finest kind of flour, there are numerous varieties that are differently preferred in different situations; and the latter species, which is often termed rye wheat, and which has also several varieties that differ little except in the colour of the chaff and the form of the ears, though it does not afford the finest sort of flour, as yielding the largest quantity of produce on loam moist clay lands, and as being less subject to injury and disease from wetness on such soils, as well as leas liable to lodge from its firmness of item, is frequently cultivated and grown on such sorts of land.

It has been observed by an able and intelligent cultivator in the county of Kent, Mr. Boys, that the number of sorts of this grain is annually increasing by importation from foreign countries. But that the old sorts are the brown and yellow lammas, the white flraw, Fulham, and the white or egg-shell. That the brown lammas was the kind chiefly cultivated in that county till within these twenty or thirty years; but that it has now given way to a variety of new kinds, as well as some of the other old sorts: experiment has, however, fhewn it to be the least productive of the several sorts. It is the common brown-flawed wheat that grows with a long jointed ear, the chaff of a dark brown colour, the flour very white, and the corn mellow in grinding, for which reason it is esteemed by the millers as the best of the old sorts for their use; and that the yellow lammas resembles the brown, in every respect, except that the colour of the grain is of a yellow hue, and the chaff of a somewhat lighter colour than the others. A red lammas with a red flraw, red ear, and red kernel, is noticed by Young as being reckoned by many farmers the best of all the sorts hitherto known, as yielding the finest and whitest flour. The first of these writers states, that the white-flawed wheat takes its name from the colour of its ear, and in other counties has the title of the Kentish white flraw. That it sends out a greater number of items from the stook or plant than the other sorts, and in that way is often a very thick crop on the land. That the flraw is generally somewhat shorter than that of many other sorts, and not quite so liable to fall in rainy seasons. That it is on these accounts much found in the eastern parts of that county; but that from its dull colour, its having a thick bran, and often grinding very feely, it is not much approved by the millers of the district. It is remarked, that the Fulham sort produces a white flour, which grows short and coarse; but that it is very productive, particularly on poor land: the grain is however coarse, and the bran thick, which circumstances render it the least valuable to the millers of any of the sorts described above. And that the white or egg-shell wheat is known by its producing a white flour, a smooth white chaff, and very white grain: the bran of which is very thick, but the flour remarkably white. It works mellow in grinding, is very early ripe, and so free in the ear as to blow out in windy weather, which is a disadvantage.

It is noticed, that of the new sorts of wheat in that county, as the hoary white, the nonpareil, the pilbeam, the square ear, the hoary brown, and the hoary white, called by some the velvet-ear'd, the last is by far the most valuable, as being very productive, and the best for the miller's use. It has the flraw white and short, the chaff covered with a thick fine down, somewhat of a brownish hue; the grain remarkably small, and of a dull white colour, the bran very thin, so that the grain in some cafes is almost transparent when held up to the light. It grinds very mellow, and makes a beautiful fine white flour. But from the quantity of the down upon the chaff, and its small ears binding up very close in the flhead, it is apt in a rainy season to vegetate too freely in the field; on which account it is not so proper to cultivate in a moist climate, and in small incloures that are not open to the influence of the sun and winds. That the nonpareil is a sort for the wanton bed to have been brought into this country from America: it has a bright flraw, with a brown ear; and the grain is very white, large, and plump. It is very productive on all sorts, thrashes very free, and yields in that operation the greater part of its chaff; thereby producing a great quantity of horfe-meat. It grinds very mellow, and is well esteemed by the millers in most districts. And that the pilbeam is a brown wheat growing very stif, and is generally thick on the land. The grain is small and plump, somewhat of a yellow-brown. It is accounted very productive on rich lands, and is a valuable kind to mix with others, but will not of itself make good bread, from its not fermenting or working properly in that operation. In regard to the square-ear'd wheat, that it is a very productive sort, but is apt to drop out in the field, before it is ripe, and in gales of wind, on which account it is not so much cultivated. And that the hoary brown is but lately introduced, confentually little known at present. And the hoary white fort, which has a white flraw, ear, and grain, is in much the same situation. That the Clarke-white, which has a red blossom, chaff, and flraw, but white grain, is much cultivated in Suffolk. That the hedge white is also white and very productive. And that the velvet white is distinct from the hoary white, is but white, not weighty, yet affording much flour, being very thin in the skin.

There are also different varieties of cone or bearded wheat, a sort which is named from the form of the ear, as has been seen above. That of the rye flraw, there are two sorts, the white and the brown, neither of which are much cultivated in Kent. They both ripen late in the season, and are fo coarse and feely, as to be unfit for making bread, unless mixed with a large proportion of a better sort of flour. They, however, produce very abundant crops on strong wet lands, as has been noticed. It is remarked, too, by Mr. Young, to be a productive sort on very poor, wet, cold
cold land, though a coarse grain, selling at an inferior price in the markets. And the bearded or rivet kind of wheat is likewise thought, by some cultivators, to be the most adapted to such kinds of rich lands as have been newly broken up, and where there may be danger of the crop lodging from too great luxuriance, as it posses the property of a greater firmness of straw or stem than the common kinds, as suggested above.

The white and the red are the sorts most esteemed in general among the polled kind; the former affording the whitest flour, but the latter has the greater produce in malt casks.

It is observed, that of the several sorts of wheat that are in cultivation in the county of Suff, the velvet-eared is preferred in the weald part of it, as having by much the thinnest skin: they there call it fluffed. It weighs on the average from fifty-nine to sixty pounds the bushel. It is said by the best judges that the white stuff on good land answers best, as being the most valuable: but that on poor land, subject to poppies, the strong-strawed sort that overpowers this weed shou'd certainly be sown.

There is a sort of wheat that obtains much on the Down parts, which is what they call Clark wheat. It is not bearded; has a red blossum, red chaff, and red straw; white grain, as already seen; the sample coarse, being in price under the finest sorts. It is, however, a great yielder, and requires to be cut forward.

The Chidham white or hedge wheat is much in cultivation, being introduced by Mr. Woods of this district. Upon trial, it is found to be a very fine sort: it is white, of a very fine berry, and remarkably long in the straw. It is now much grown in many of the southern as well as northern counties.

In the county of Essex, according to the Corrected Report on the Agriculture of that district, Mr. Kemp of Hedingham compared wheat from Italy, from Scotland, and from Danzig; the last by far the best, and next the Scotch; but the Italian was full of flint in spite of every attention in brining and liming; and sowing it a second time with still more precaution, the result was the same.

About Burnham, some cultivate a sort of wheat from Italy, which they approve of much; the straw is remarkably stilt and stiff. They cultivate also a sort called the Saffodite; red grain, red chaff, and purple straw; this is a very good sort. The Taunton Dean, too, is beautiful, but will not bear rough weather. For two years past the Hamburgh white, with white grain, and white chaff, has been a fashionable sort; the white American wheat is also used.

The sorts most usually sown about Kelvedon are the burrel red chalk, and red grain; and the white rough; white chalk, and white grain, the chalk rough; this straw stands the weather well, and does not shell easily: but is rather difficult to thrash. About Langenhoe they generally sow wheat on heavy land, and rarely rivets, rough chalk. York white, also American red. Some other of the above sorts are like-wise in use.

It is remarked that a few years ago, as a person at Bradfield was walking through his wheat-fields when the corn was in full blossum, he was struck with the variety of hues, or colours, which the blossoms assumed: at first he conceived it might be owing to the different shades of forwardness in the blossum; but on particular examination and more mature reflection concluded that they were certain signs of a specific difference in the quality of the wheat; impressed with this idea, he selected the ears of different hues, and particularly marked eleven distinct numbers; noting very minutely their characteristic qualities and appearances in the field. Thefe he gathered and kept separate when ripe, and planted them apart from each other in his garden: the same characteristic difference was observed to continue upon the several numbers when growing in the garden as was observed in the field the preceding summer, and are as below.

First year in the garden culture.—No. 1. A stiff straw, thick ear, the rows or chefts in which set closer than in any other.
2. Dark straw, full blade, and large open ear.
3. A large long ear, ripened late, and well set.
4. Full foliage, and a long open ear.
5. Straight handsome straw, large well-set ears, flag or leaf small.
6. Red rusty leaf before spindling, red straw with little leaf at harvest and smaller ears than any.
7. Very like No. 6. in straw, the ears small, but well set.
8. Straw leafy at harvest, of a good colour, well eared and handsome.
9. 10. Straw full of flag or leaf at harvest, ears well open.
11. Very like No. 5.
Second year in the garden culture.—No. 1. Short upright stuff straw, thick well-set ears, and later by four or five days than any of the others.
2. Very dark straw, upon which there remained a full dark blade at harvest; long open ears.
3. Strong leafy straw, of a good colour, with a thick long ear, well set, rather later than Nos. 5, 8, and 11.
4. Thick leafy brown straw, with a small ear.
5, 8, 11. Short handsome bright leafy straw; ears long, thick and well set.
6. Long straw with a good deal of flag, ears ill set and open.
7. Straw handsome, but small ears, and subject to root-falling.
9, 10. Long weak straw, very leafy, and subject to root-falling.

It is observed on these, that the lemon-coloured blossum was observed to attend Nos. 5, 8, and 11; but the colour of Nos. 1 and 3, was not particularly remembered. These are the numbers which had been preferred, Nos. 5, 8, and 11, coming to the sickle about a week earlier than Nos. 1 and 3; the produce of which, when compared with the rejected numbers, is an excess of from six to eight bushels per acre, and weighing about three pounds more to the bushel.

At Bradwell, it is observed, a crop of Windsor wheat was had, white grain, white straw, and white chaff, which was a most beautiful sample; the strength of the straw middling.

That of all the different sorts of wheat Mr. Hardy has tried on his farm, the best has been the white egg-shell, and this is the sort most cultivated in Foulness island.

That the red American is a sort which yields remarkably well with some; it is much approved in Mersea isle. Some have had the best success with it. But Mr. Strutt, at Terling, sowed a barrel of remarkably beautiful wheat from New York, in part of a field, the rest of which was sown with English wheat, and the American was so bright and cheerful in the ears as to produce a poor and miserable grain both in quality and quantity. He sowed it again, and the result was the same, and repeated the experiment the third time, the result again the same, though the adjoining English wheat in all the three years produced a fair crop free from all blight. The habit of this wheat, therefore, was not, it is said, changed in three years sowing.

That the rough chalk, a white chalk and white grain, with a velvet
a velvet ear; is found about Burnham to be an excellent
fort; for there they are subject to strong easterly winds, and
it does not shell easily. But fome, however, do not like it
on heavy land, as it has not straw enough; and think that
it should stand till ripe, or it will not thrive well.

And about Hallingburg Rife, and indeed through all the
district of the Roddings, they find the rivet fort a very use-
ful wheat, which is very general, and is found to yield on
that heavy foil much better crops than any common fort;
but on lighter foils the Kentish red.

In Norfolk about Reddlefworth they have an opinion
that red wheat will not anfer on black land, white succeed-
ing to much better advantage. But at Winborough red is
only fown by Mr. Salter, the white forts not anfering fo
well on the heavy foils: it is termed the old red. Some pre-
fer the red chalk, or red wheat to the white, as being les
liable to grow at harveft; white however is a better fample,
and produces a better price.

In Hertfordshire the rivet or bearded fort is the common
fort on the clays and strong loams about Sawbridgworth,
on which it yields more abundantly than the red and white
wheats, four or five quarters per acre not being uncommon
in favourable years. And a fort termed "polled rivets" is also
very productive, one hundred grains having been feen in an
car.

About St. Alban's, Day's stout, which has the ears grow-
ing with four fets of kernels, is much fown; also about
Hitchen, where it was discoered by a poor labourer who
gathered a few ears. It is faid to yield well. It is sup-
pofed to be the pinks of Ellis. The red lamas and Lujefull,
brung from Cambrieghire, are likewise much fown. On
the Albury clays the rivets are grown, yielding largely, but
subject to mildew, and felling badly with indifferent fraw.
They have a blue and white fort; the latter is preferred.

In moft other counties, the fame forts of wheat are like-
wise cultivated and grown with fome other varieties.

In addition to thefe, there is, however, another species or
fort of this grain, which is now much cultivated in fome
cafes, as that which is known by the name of spring-wheat.
This is a fort of wheat that is capable of being put into the
ground at the fame time with other grain crops, in the early
spring months. The cultivation of it has been long prac-
ticed, in fome degree, in both the northern and southern
parts of the ifland; but of late a much greater attention has
been bellowed upon it, and at preftent it is raised and grown
to considerable extent in different districts and places, as in
the fens of Lincolnshire and Cambrieghire, in many parts
of Oxfordshire, in fome iflands in Berkshire, in Hertford-
shire, where it is found to anfer well, and in moft of the
other fouthern counties, as well as in many parts of the
north of England, and even in the lower parts of Scot-
lend, with the greatest fuccefs, where the bottom in the land
is somewhat inclined to be firm and clofe.

In regard to the spring fort of this grain, it would feem
to be capable of being cultivated on the ftrong and heavy,
as well as on the lighter forts of land; but that it is the
most calculated for the latter, where the vegetation and
growth are rapid, particularly fuch fenny lands as have a firm
surfet-earthly bottom. In thefe it fives in a very quick manner,
and they are not by any means well suited for the winter forts
of wheat from their lightnefs, rendering them liable to be
thrown out in that feaon.

Preparation of the Land.—Wheat is a crop that is usually
grown after the land has been prepared by repeated plough-
ning and harrowing or fummer fallowing; but which is often
capable of being raised after different kinds of green crops,
as well as those of the root and other forts with equal or
more advantage. In fome cafes, falk and hemp also afford
a good preparation for this grain; but fome consider beans as
the most favourable preparation: and experiment has fhewn
tares, and clover, to be nearly equal to them in this inten-
tion. In the county of Norfolk, wheat almoft conftantly
succeeds clover, except where pea or bean crops are in-
pofed, the land being fearecly ever fallowed with this view,
except in the infances of what are termed "afflard unmer
ills." It has indeed been well obferved, that if there is one
practice in husbandry proved by modern improvement to be
worfe than another, it is that of fowing wheat on fallows;
it is therefore only flated on this point, that in fome counties
the fallows are ploughed juft before harveft on to two-fout
ridges ready to plough and fow under the furrow in the
fparing method, a feelfman to every plough which reveral
the ridges. In others they lay their lands into ten or twelve
furrow-fitches or ridges, and sowe fome under the furrow,
some under the harrow. That the ridges vary exceedingly,
according to their wetnens; and that in Kent they have by
means of the turn-wrel plough, no lands at all, but a whole
field, one even surface. It would be ufeles to expatiate on the
circumstances of fallow-wheat which ought no where to
be found. If fallows be or are thought necessary, let
them be fown for barley or oats, or with any thing but
wheat. However, in whatever manner or after whatever
crop this fort of grain may be cultivated, the foil
should conftantly undergo that fort of preparation that may
be fufficient, according to the particular circumstances of
the land, to bring it into a flate of coniderable finenesf
mould, efpecially in the more superfical parts, and thereby
prevent as much as pofible the rifing of weeds: for it has
been wef noticed by a late writer, that whoever has attended
to the progres of this fort of crop, in fuch lands as have
been well broken down and reduced, and in fuch as have
been left in a lumpy crude flate at the time of fowing, will
have found the difference to be very coniderable. But it
may be noticed, that when this kind of crop is taken after
clover, the land seldom undergoes more than one ploughing,
which is moftly given immediately before the feed is fown.
However, as the graify matter, in many cafes where this mode
is adopted, is extremly apt to rise and injure the crops in
the more early fages of their growth, it may be better to
follow the practice adopted in some districts of using a skim-
cultered plough, as by this contrivance the remains of the
clover weeds, and graify material on the furface, may be cut
or skimmed off, and turned into the bottom of the furrows,
where they are immediately covered with the leafe mould
from below to such a depth, that little or no inconvenience
can be fubfained by them, while the land is thus rendered
more clean, and capable of being harrowed in a more per-
fect manner than where the common plough only is em-
ployed.
ployed. Besides, perhaps, a better bed of mould is turned up in this way for the feed to vegetate in, provided the furrow is not made of too great a depth and breadth, and remain some time before it is sown; which should constantly be attended to by the agriculturist in preparing this sort of ground for wheat-crops. But it is the custom of some counties, as of Norfolk and Warwick, where the land is often continued for nearly two years in a state of clover, to break them up in the latter end of June; in the second, giving two, and sometimes three ploughings. Where the situation is favourable and the weather turns out suitable for reducing the soil to a proper state of tilth, this may be an advantageous practice, as by such means great benefit may be obtained by cutting the grafts in the beginning of the season, in which it is to be ploughed up; but where circumstances of so favourable a nature do not occur, such a method of preparation must be less beneficial than that of giving only one ploughing. In the preparation of a clover ley for wheat, Mr. Duckett has noticed a singular experiment and practice. He had a field in which wheat rarely escaped being greatly root-fallen; not to lose sowing it with that grain, and at the same time to guard against the experienced malady, he sown it repeatedly, till he had torn up the clover, and also produced tilth enough for drilling it in; then he collected the clover fragments, and carted them into the farm-yard to make dung, and drilled the field; the wheat having a firm bottom in an untilled soil, escaped the disease, and yielded an ample produce. The clover bulbs, which would have secured the dreaded loofenets of foil, had it been turned down, made a large quantity of dung, and therefore was not left to the farm, though the particular field was deprived of it. And it has been stated on the authority of a cultivator of much experience, that in cafes where the clover-crops have been such as to leave the land in a foul condition in respect to weeds, it would be highly improper to sow them with this sort of grain, as from its remaining for such a great length of time upon the ground they may be liable to have their feeds perfectly evolved, and brought into a state of vegetation. In such cafes, it has been suggested as more advantageous to have recourse to such sort of crops as may require the operation of hoeing during the time they are upon the ground. The putting in of wheat after pea-crops, is a practice that may probably be purified with the most propriety and success in those districts that are, from the nature of their situation, sufficiently early to admit of the land being fully cleaned and prepared by repeated ploughings and harrowings, after such crops have been removed, before the proper time of sowing such grain. But where they are so late as to allow of the land being prepared by one ploughing before the period of sowing, it is supposed by some to be an extremely hazardous practice to attempt the culture of wheat after such crops; as unless the ground be in a high state of tilth, there is little chance of a good crop being produced. This is the opinion of the writer of the work on modern agriculture; but the Norfolk farmers are in the constant habit of setting or sowing in wheat upon a pea-flubble with a single ploughing, and confide in it a very safe and excellent husbandry. The pea-crop ought, however, to have been kept clean; and after it is harvested, the haum harrowed off. They never plough a bean-flubble there more than once. In some counties, it is the constant practice to cultivate beans and wheat alternately on the same land for some time. This is the case on the flarger kinds of soil in the county of Kent, on which it is found to answer in a very advantageous manner; and where wheat is only occasionally sown after such crops, it is often found an useful practice; but in all such cafes the beans should be cultivated in drills at from twenty to thirty inches distance, in order that they may admit of being hand and horse loosed in the most perfect manner. If this method has been followed, and the business of hoeing during the growth of the crops effectually performed, the land may be sufficiently prepared for the succeeding wheat-crops by one ploughing, as the soil from being thus kept clean, and in high tilth, can scarcely fail of affording a good produce. It has been remarked, that where the farmer has a bean-flubble intended to be sown with wheat, he should give it the due tillage as early as possible, which should be regulated by the soil, as on some it may be better to trust the skim scuffleers and scariers than the plough. That where the land is very clean, the great skim of the isle of Thanet is capable of cutting through every thing, and loosening the surface sufficiently to enable the harrows to render it as fine as possible, being picked and burned by women. Where not so clean, the Kentish broodthur may be more effective. In other cafes, the scuffle may be sufficient for the purposes. It is noticed that in this cafe, where the farmer has got the surface to his mind, he is to consider whether or not he should plough it, which is advisable if the soil be of a firm, solid tenacious quality, and if he does not intend to drill the wheat: if he should plough such a soil he may not have any apprehension of root-fallen wheat, that is, failing roots, from a loose bottom; but he will bring up a new surface that may drill with difficulty, whereas that which has received the influences of the crop, atmosphere, and of his late operations, will be in exactly the right temper for the drill to work in. If the soil is of a more loose friable quality, and he should plough down the fine surface he has gained, he will give the wheat too loose a bottom, and he will run the chance of a root-fallen crop. In all such cafes, or in any that have a tendency to this circumstance, he should determine not to plough at all, but drill directly; a method in which he faves tillage, and has the probability of a better produce.

This is rather a new practice on strong land, but such successes have been seen in it as leaves no reason for doubting the soundness of its principles. It was done by Mr. Duckett on a sandy soil for years, and with great effect. It should be remembered, that whatever other circumstances may influence the growth of this grain, it loves a firm bottom to root in, and rarely flourishes to advantage where it is loose and crumbly; nor will a depth of such mould do, if the under stratum, in which it will attempt to fix its roots, be from its quality of a repellant nature. The best basis is the cultivable soil, firm from not having been lately disturbed. These observations, as being quite practical, are certainly deserving of the farmer's attention. Where the district is early, and the land is preferred in good order by proper modes of cropping, wheat may be grown after beans, whether cultivated in the drill or broad-cast system, with successes, as there may be sufficient time to give the necessary preparation before the time of sowing, which cannot be done where they are late, and there is only time for one ploughing. But in other situations it is found advantageous when this crop is to be grown after either peas, beans, or tares, to plough the land in as light or shallow a manner as possible; and then harrow and take out the roots and weeds, so that they may be consumed on the ground in heaps; the field being after this formed into proper ridges for the reception of the feed by ploughing again a few inches deeper than the first. And in some cafes, it is even harrowed after the second ploughing, and ploughed a third time for the putting in of the grain.

Wheat, too, may sometimes be cultivated after turnip-crops to advantage on the heavier turnip-soils, particularly
WHEAT.

where they have been kept clean from weeds by repeated hoeings, and fed off upon the land at such early periods as to admit of the ground being prepared by once ploughing, in a light manner. In cases where this kind of crop is intended to be cultivated after potatoes, which, from their having a great tendency to lighten the soil as well as to exhaust it, should never be done on the lighter sorts of land in backward situations, or under any circumstances where a sufficient proportion of manure has not been applied for the potato-crops, one light ploughing immediately before the feed may be in most cases an adequate preparation; and where proper attention has been bestowed in the culture of such crops, the soil is generally left in a sufficiently fine condition for the purpose. It has been remarked, that the cause of wheat not succeeding well after potato-crops, in many instances, is, that besides the land being rendered too light and porous by the growth and cultigation that are requisite for them, the wheat is more exposed to the injurious attacks of the grub, earth-worm, and other insects; and in some exposed situations, from the seed-time being too long protracted, the practice becomes obviously improper. In growing the crop after those of hemp and flax, as weeds are apt to thrive, it is always proper that the soil should be ploughed over two or three times, in order that a fine flate of tilth may be produced. The custom of giving but one earth after such sorts of crops, can seldom or ever ensure full returns of this grain. It has been remarked in "Practical Agriculture," on the best authority, that experience has shown, in the most clear and satisfactory manner, that this sort of crop should never, when it can be avoided, be grown after other kinds of grain-crops, as rye, barley, or oats; and that the manure should not be applied to it, but for such crops as may precede it. That where the contrary is practised, the crop is not only liable to be injured by the rampant growth of weeds, but from its being more apt to be diseased.

On the whole, it may be observed, that whatever the nature or state of the ground may be, or the kinds of crops that precede this sort of grain, it would appear that the preparation for it should always be such as has a tendency to reduce the parts of the soil to a pretty fine flate, as under such circumstances the growth of the crops is not only more regular and perfect, but from the even and compact flate in which the surface is left, it is more fit for affording support and protection to the roots of the wheat-plants, as allowing them to spread and extend themselves with greater readiness in the fine mouldy earth thus provided, as well as by its falling down more closely about them. It has, however, been contended by some cultivators, that a rough cloudy flate of the surface-part of the land is the most proper situation for it of the reception of this kind of crop, as the young wheat-plants are thereby better guarded and secured against the effects of the severe cold that often takes place in the winter season. It is probable, however, that cold is seldom hurtful, in any great degree, to winter wheats, except when accompanied with too much moisture, or where sudden frosts and thaws have the effect of rendering the surface parts of the soil too light and open, as to be incapable of affording proper support to the roots of the young wheat-plants.

In Berkshire they prepare the land for wheat chiefly in three different ways, as by summer fallowing, and manuring with yard-dung, compost, rags, foot, and chalk in some cases; by folding on it with sheep in cases where the ground is not of too deep and wet a nature; and by putting it in on the back of clover-leys, after one or two crops of grass by one or more ploughings.

It is thought by some, however, that manuring for beans or other crops is a much better practice when followed by wheat, than the old custom of fallowing and manuring for this crop, which renders the land too light, and consequently subject to blight.

The farmers in Oxfordshire prepare for wheat by different numbers of ploughings, as the circumstances of the land may be; but the layers are mostly ploughed in a shallow manner, as wheat loves a firm bottom to root in, and which, in sandy land, cannot be too tight. Too loose a bottom is apt to cause a root-fallen crop.

An equally careful preparation of the soil is necessary for the spring crop of this grain, though fewer ploughings will often be sufficient.

Time of Sowings.—In regard to the proper period of sowing this sort of crop, it may, the author of Modern Husbandry observes, be useful to remark, that the earlier the autumnal sowings can be put into the soil, the greater chance the young plants will have of being well established before the frosts take place, which has been seen to be a circumstance on which the welfare of the crop in a great measure depends. Besides, the state of the land and that of the season are much more proper for the processes of vegetation, when the crop is put in at an early period, than when it is delayed till a late one; the state of the weather in the latter case often admitting of only a very languid and imperfect growth till the spring, by which the crop must be exposed to much danger from various causes. Indeed experience has abundantly shewn that late sown wheats seldom succeeds so well, or afford such plentiful crops as those that are put in early. But when sown too early there may notwithstanding be danger of the crop running too much to straw, and consequently of the grain proving light in the ear. From the beginning of September to the middle, or even the end of October, may probably be considered as the most favourable period for this business. This is indeed confirmed by the established practice of the most correct farmers in almost every district of the kingdom where this sort of grain is grown. If sown earlier, especially on the heavy kinds of soils, the land is for the most part in too hard and lumpy a flate to allow of the seed being properly covered by the harrow; and in the lighter ones in too dry a condition for the grain to vegetate in a proper manner; and when delayed later, the ground in one case is apt to become too wet and close by the falling of the autumnal rains, and in the other too loose and porous from the action of the frost upon it. It is remarked by the writer just mentioned, that more than four-fifths of the whole of this sort of grain is sown between the middle of the first and the end of the last of the above months. Mr. Young thinks September the best season for cold backward wet soils, and October for those of the more dry and warm kinds, after which there has been a plentiful rain. There are, however, circumstances, it is farther observed, on the authority of the Synopsis of Husbandry, that may render the times of sowing different from the above; as where the soils are of the rich fertile, loamy, chalky, or gravelly kinds, it may be better to defer it in many instances to a considerably later period; and when such warm sorts of land are cropped too early, they are apt, it is said, to push the plants forward in such a rapid manner, that they become weak and spindling in the early spring months, and at the same time the crops are more liable to be infested with weeds, on account of the season being more favourable to their growth. But that the practice of putting in crops of this sort so late as the latter end of November and beginning of December, frequently depends on the crops that precede them not being capable, from the lateness
of the situation, or other causes, of being taken off so early as that the land may be made for the wheat-crop in the proper time. This is often the case after peas, beans, tares, turnips, and other similar crops. In these cases, on the lighter sorts of soils, and where dress culture is employed, it may often be an advisable practice to sow in the spring, as by such a delay the ground may be brought into a more perfect state of preparation than could be the case in sowing it so late in the winter.

It is indeed remarked in the Corrected Report on Agriculture for Middlesex, that those persons who sow wheat in autumn lose the great advantage of a previous crop of turnips, both as to depleting the weeds and manuring the land; and that they cannot induce the labour of either hoeing, harrow, or otherwise tampering with the weeds and young wheat in the following spring. That a wet seed-time sometimes renders it impossible for the farmer of a clayey soil to sow his usual quantity of wheat in autumn; this should not induce him to sow his grain when the land is too wet for the occasion, but rather let him wait till the first favourable opportunity in the months of February or March, by which time frost will have rendered the land mellow, and then he should sow the residue of his wheat; as the probability is great that wheat sown on a mellow soil, in a dry February, will be more productive than if it had been sown on the same land, in an adhesive state, during a wet November.

That autumnal-sown wheat precludes cultivation for one entire year, which, apart from all other circumstances, gives great encouragement to the growth of weeds; but that in order to appreciate the great mischief done by sowing wheat in that season, its connection with the usual course of crops must be taken into consideration. For instance, first, in the ancient, and still very common course of fallow, wheat, oats, there is seldom any ploughing from the sowing of the wheat until the sowing of the oats, which is one year and a half; secondly, in the course of wheat, clover, spring corn, or pulse, there are two years together in which the plough cannot possibly be put into the ground; thirdly, in the valuable course of turnips, barley, clover, and wheat, the plough is shut out of the ground for two years and a half. That these three courses include most of the arable land in Britain, and they demonstrate the prodigious encouragement which such courses give to the growth of weeds. On the contrary, wheat sown in the spring occupies the ground only half a year; and that when that is placed in a succession with winter tares and turnips every two years, the weeds have not time to grow in such a manner as to do any material injury. There is no period in such a course of more than six months in summer, or eight in the winter, free from the operation of the plough. This degree of tillage keeps the land free of weeds, and, in that manner, prepares it from being exhausted by them; and, by giving the green and root crops to sheep and other cattle, on the land, it becomes doubly manured every other year, which cannot fail to force the growth of the wheat as though it were growing in a hot-bed.

It certainly is not in every possible case advisable to refrain from sowing wheat in the autumn, in order to sow it in the spring. A dry seed-time is of so much importance to the occupiers of adhesive and fenny soils, that they should not let any such time pass without sowing their grain. In the case of a dry autumn, which is the same thing as a fine seed-time, the farmers should sow all such land as is then ready, and thereby ensure the important points of a good seed-bed for their grain, and against the danger of a wet spring. On the other hand, the more rain that falls in autumn, the better chance there is of having a dry spring; and consequently in every wet autumn the wheat-sowing should be postponed until the spring. The proof of the success of one instance of this kind may enable farmers to judge what is capable of being effected, even in an unfavourable situation, by patience in wet seafons, and exertion in such as are dry. A large wheat-farmer, near Haddingston, in Scotland, owing to a wet autumn, delayed fowing his wheat until after the 19th day of February, between that time and the middle of March, feeding one hundred and forty-five acres with wheat, principally the Effex white and Egyptian red. The harvest in this case was about ten days later than usual, and the crop yielded from twenty-four to forty Winchmiller bushels on the acre, which weighed nearly sixty-two pounds each. On examination, the wheat was found a first-rate sample.

Such a successful case of raising fine wheat from the seed sown in the spring may afford reason for putting it in at that season in many cases. Such a practice has never been known to fail, by the writer, when performed early, and on land in good heart. The advantages of the practice are said to be many, and very considerable.

When the sowing is to be done later than the above periods in the spring, the true summer wheat is always to be used.

The exact periods at which this sowing of grain may be put into the ground in different cases with the greatest chance of success, under different circumstances of soil and climate, have not hitherto, however, so far as we know, been fully ascertained and shown by any correct trials; but the above periods of autumn sowing are in very common use by the best farmers.

In the counties of Effex, Suffix, Hertford, Oxford, and many others, most of the best farmers are in favour of early sowing; but more to the east it is done somewhat later. In Berkshire they sow their light lands early, and those that are rich at a later period.

The spring sowing of wheat may be sown from about the middle of March to the end of the following month, in most parts towards the south; but most probably the sooner it is put in after that period of the above month, as the state of the seaso will permit, the better it will be in the crop or produce.

Seed.—In respect to the proportion of feed that is necessary in different cases, it must depend upon and be regulated by a variety of different circumstances, but in general from two to three bushels, according to the state of the soil, the nature of the climate, and the period in which it is put into the ground, may be the most suitable proportion for soils of a medium state of fertility, under the broad-cast method of husbandry; but where the drill system of culture is practised, a considerable less quantity may be sufficient for the purpose. In the drilling and dibbling methods of sowing, however, which are unquestionably the best where they are performed with correctness, six pecks of seed are sufficient; in the latter method two rows being put in on a flag, care being taken to have the land rolled after having been ploughed a fortnight or more, and the seed dibbled in to a sufficient depth, without scattering, covering it in by harrowing.

Where the lands have a known disposition to mildew, a larger proportion of feed should be given, whatever the time or season in which it is put in may be. Much less feed is also necessary in early than late sowings. It is remarked that on the rich soils of Gloucestershire, the quantity generally sown is about seven pecks, while in Yorkshire it is from eight to twelve. Where the lands are in a suitable state of tillage for receiving crops of this grain, ten pecks have been advised by a practical writer as the medium proportion; but
WHEAT.

but much larger quantities are frequently sown in the northern parts of the kingdom. It is obvious, however, that where such large proportions of feed are made use of, the plants must be liable to be drawn up too much, and the crops in consequence to become weak and imperfection fed, as well as smaller in the size of the ears. There may be also disadvantages from making use of too small proportions of feed, from the ground not being properly covered with plants; but where care is taken in the after-culture of the crops, less danger is probably to be apprehended from this than the other extreme; as a great number of plants will be supplied by the lattering or shooting out of new items from the joints about the surface, in consequence of the mould being laid up against them.

In Hertfordshire, in the broad-call method, from two to three bushels are usually sown. But in the county of Norfolk they sow broad-call, from two to two and a half bushels; and in the drilling and dibbling methods, from five to six or seven pecks.

In Essex they sow broad-call about two and a half bushels; and in the drilling and dibbling modes, from seven to ten or more pecks.

In Suffolk they sow a large quantity of feed, some four bushels on ley land, and three upon tillage; others three and a half; but when this crop succeeds peas, only three, if it be early, but if late, more. The medium quantity is about three.

In Berkshire commonly from two and a half to three in the broad-call sowings of this crop.

And in Oxfordshire from two to two and a half, and sometimes three.

In the sowing of the spring fowling of this grain, the quantity made use of is various. Some, for a full crop, sow fourteen pecks to the acre, but with grases-feeds only nine. Eight pecks have produced an abundant crop in some cases, on the same portion of land. Others advise two bushels to the acre; and say that the earlier it is sown the better seed will be required. Sometimes three bushels are sown upon the acre. However, from two and a half to three bushels on the acre may be considered as the most proper quantity. In the dibbling method, four pecks and a half have been found sufficient for an acre and a half.

The broad-call practice of putting this sort of crop into the ground is the most common on the heavier kinds of wheat-lands, as those of the clayey and loamy faw, the feed being harrowed well in by a rather light harrow. But in the lighter faw of wheat-lands, the drilling method is often practised when they are clean, and sufficiently mellow and mouldy on the surface. Sometimes, too, the feed is put in partly by the plough, and partly by the harrow. In some districts it is ploughed in on the fawls, and harrowed in on clover. The clover-leys are also occasionally ploughed in some cases, and have the feed scattered in, and folded upon by sheep. See Sowing, Seed, &c. Also Under-Furrow Sowing.

Some farmers prefer a stale furrow for fowing wheat upon, while others are in favour of the contrary practice. A stale furrow is probably, however, the best in many cases. See Stale-Furrow.

Preparing feed-wheat for fowing is practised in many cases and places in different modes and manners. See Pickling, Steeping, &c. Also Wheat-Seed, Liming of.

The depth of putting the feed in should not probably be more from one to two or three inches.

In some parts of Oxfordshire the last is the usual depth, and the farmers are generally friendly to depositing the feed to a shallow depth.

It is also the practice with many farmers in these different districts to change their feed-wheat frequently.

In the county of Suffex, an intelligent and spirited farmer has found by long and attentive experience that a change of feed-wheat is of essential importance to the cultivator, that feed which has been repeatedly sown over the same ground at length degenerates, and the produce each succeeding year becomes inferior in quality; on which account, wheat that is apt to run to flour is sown on ley-land, and the Hertfordshire white fow upon rice.

In other districts the practice is thought by the best farmers to be always proper; and that the feed-wheat should be brought from a colder soil or land than that on which it is to be sown. See Change of Seed, and Seed.

As soon as the feed has been put into the land, it should constantly be laid as dry as possible by the construction of proper drains and water-furrows, so as in all seasons to keep the water from flagrantly upon it. See Water-Furrowing.

It has been lately suggested as a beneficial practice to have the feed-wheat well trodden in at the time of fowing it by sheep, or fill heavier rocks, on heavy as well as light soils; as by this means the young plants are prevented from dying away in the winter, from the land lying too light and hollow. But more facts are wanting to establish the utility of this method of practice in different cases. See Treading Wheat in, and Plough.

Although under the present practice and management in the cultivation of wheat, the autumn or winter fowling must always necessarily occupy a large extent of the heavier kinds of wheat-lands in this country, and be raised in the manner that has been directed above; yet in a number of cases the true spring fowling is found favorable, grown, and had recourse to with great advantage, success, and profit. But in all such climates, the real summer fowling must always be employed, for though the winter kind may be put into the ground with advantage in many cases to late as after the middle of February, as has been seen above, it is better to have this real fowling last year, as it poises many properties highly necessary for the purpose. By some it has been supposed that it would interfere with winter wheat, and that it may be difficult to find proper courses for introducing it in. However, this sort of wheat should principally be cultivated and grown on soils or lands, and in climates which are not well suited for winter wheat, or in cases where that sort is particularly liable to mildew. But though it may not be suited for universal application, it is most likely to succeed in the lighter, the sandy, and the saltier sorts of soils, where the winter wheat is apt to be thrown out of the earth by frothy seafons. In such cases the courses might be turcks, or rape, according to the nature of the land, spring wheat, clover, and oats, or some such rotations, as in such, if after the clover or other grasses, the land be paroled for one year, the oat crops will be certain, and abundantly productive.

The preparation in some cases might be the rendering the land fine and clean by one or more ploughings and proper harrowing, and in others by ploughing and burning, and fowing cole and other seeds and crops, for being fed off by sheep, or in some other such ways.

In this manner large crops have been raised in many different instances, as thirty Winchester bushels, or more, on the acre, which were ripe and ready at the same time with the other spring-fowling grain. It is a wheat which is said to yield...
yield as much flour in any given quantity as other wheats, and which does not appear to be subject to any disease, nor to have any disadvantages attending the cultivation of it. It does not require more manure than barley or beans, nor does it exhaust the land more. Itanswers extremely well for laying down with clover, in which case the clover-feed should be fown and harrowed in with the last harrowing for the wheat, and the usual quantity of grass-feeds sown. It is to be preferred to all other sorts of corn for raising crops of grass-feeds; owing to the small quantity of leaf which it bears, and which is of short duration, as it fades and falls down almost as soon as it has attained its full size; more air is thus admitted to promote the growth of the clover, or other grasses; and the admixture of more air may also contribute to prevent the mildew with which this sort of wheat is so rarely affected.

There is a further advantage flattered to arise in the cultivation of this sort of wheat in some cases, which is, that on various soils, and in some situations, it often happens that the autumnal-fown crop of wheat may be fown to fall and to go off in patches, from the injury of the wire-worms, or other causes. Consequently, that in the beginning of April, by raking spring wheat into the vacant places, as also where the wheat-plants may appear weak and thin, the uniformity of the crop may be restored, and the spring wheat be ready for the sickle quite as early as the autumnal fown. And that, although such a mixed crop would render its produce highly improper for feed; the miller's use it would afford no objection.

The remarks that are given below are the result of much experience and practice in the cultivation of this sort of wheat. It is found that crops of this kind are ready to cut quite as early as the autumnal-fown wheat in similar soils and situations. That it is highly probable that the succcass of this sort of wheat on clover ley may be found to depend more on the coming feason than autumnal-fown wheat; as if the following feason should prove dry, the crop would be more hazardous in the former than in the latter. In a dry summer it would seem that this wheat would have a better chance upon land that has been longer upon tillage than upon clover ley. That turnip and rape fallows, where the soil is not too light, seem highly proper for spring wheat. That pea and bean fallows may also in many instances prove eligible for spring wheat; and especially after having been ploughed early in the autumn, and benefited by the winter's rains and frosts. That when the spring wheat is sown in, the last light harrowing, clover-feeds, &c. may be fown, the ground will most likely be well set, and the seeds proper equal to any in other cases. That in the application of top-dressings for this sort of wheat, it may seem, that in a long-continued dry feason, the most eligible way would be by applying them at the same time when the wheat is fown. Only once lightly harrowing after may suffice. But that, in a moist and continued rainy season, top-dressing would probably prove to act more powerfully by being sown upon the surface of the soil; because top-dressings are most particularly calculated to invigorate the coronal roots of the wheat-plants, and thereby to cause them to tiller well. And that, when top-dressings are sown on the surface of the soil, the best time of applying them, it may seem, would be when the wheat is grown to the height of three or four inches; because if laid on before the blades of the corn-crop afford a kind of shelter, the finer particles thereof are liable either to be exhaled by the sun, or blown away by high winds, which frequently occur at such seasons. Moist and showery weather, at that critical period, will always be found of the highest importance; therefore, the farmer would do well by having due attention to the state of the weather when employed on this business. And that, as a crop of this sort of wheat is so much more valuable than any other kind of spring-fown corn, there are good grounds for supposing that top-dressings cannot any other way be more beneficially employed.

Trials with this sort of wheat in other unfavourable cases of poor wet cold land likewise shew that this sort of grain may be had recourse to with considerable success in different cases. That five quarters per acre have been had on rich good land in perfect cultivation of excellent wheat of this kind, when put into the foil so late as the 4th of May. It is evident, that this sort of wheat has a rapid growth, being equally forward at harvest with the autumn-fown crops. That on the whole it seems probable, from the successes that has attended this kind of culture in the fenn, in the southern and the more northern districts of the kingdom, that it may be advantageously introduced in many different situations and circumstances of arable land.

We have already considered the history, nature, qualities, and many other properties and circumstances in relation to this sort of grain. See SPRING-WHEAT.

Culture noble growing.—In the culture of wheat after it has been put into the soil, there may be some difference, according as it has been fown, according to the preparation of the land, or other circumstances. But in all cases it should be kept perfectly clean and free from weeds, either by the hoe or hand hoe, as weeds not only injure the crop in its growth, but lessen the value of its sample when brought to the market. And besides, the stirring of the mould on the surface amongst the plants may frequently be useful in other ways, in addition to that of preventing the growth of weed-seeds; for as in the heavy kinds of soils that are moist adapted to this grain, the more superficial parts are liable to become foul and baked as not to be easily penetrated by the new-formed or coronal roots of the plants in the early spring months, especially when they are very dry, and have been preceded by much wet; loofening of the earth, by any means whatever, mull of course be of great utility. This effect is generally shewn to have taken place by the appearance and progres of the crop, which becomes of an unhealthy yellow colour, and advances but little in its growth. In such cases it has been suggested that harrowing once or oftener in a place may be of much service in the early spring months. Where the crops are thin, and of feeble growth, this operation may produce beneficial effects, by affording a sort of earthing up to the weak plants, and thereby promote a more vigorous growth, at the same time that a number of new shoots are sent off from the joints thus covered, and the crop in consequence rendered more full and abundant; and where the grain is too thick upon the ground, it may also be of utility by drawing out and destroying many of the plants. It has likewise been suspected by Dr. Darwin, that many of the root-fibres, by being torn in the operation, may prevent the over luxuriance of the stem and leaves, and by that means promote the more early fructification of the grain.

It has been observed by a late writer, that the practice of fcarifying the young drilled whet-crops should constantly be performed in an effectual manner, and not later than March; but that some have not supposed it to be so very beneficial, from not performing it at the proper time. Mr. Cook has, it is said, contrived two implements for this use, a fixed harrow and scarifier; the former executing its work merely by common tines or teeth, having three rows, which,
by varying its position diagonally, one, two, or three of
them may be brought to act in the space of nine inches,
without injury to the rows of wheat-plants. If two, they
may, it is said, be drawn in a breadth of three inches; if
three, in a space of four inches, and these spaces widened
at pleasure, but still so as to keep quite clear of the rows of
wheat; and that by loading the harrow, the teeth are
forced to a proper depth. Further, that the earlifer has
teeth of various breadths; but for working at this seaso,
between nine and twelve-inch rows, the narrowest are to be
preferred. By the action of these tools the surface mould
is, it is remarked, loofened, and the air admitted, being
performed to the depth of two inches with safety, and
without mould being raised so as to cover or bury the
plants, the earth being only loofened, and not displaced.
By these contrivances much work can be accomplished in
a very short time. This procés is also useful against the
attacks of the worms. They horfe and hand hoe their
wheat-crops repeatedly in Eiflex, and with great advantage,
though very expensive.

But the drilled and dibbled crops, where this method is
not employed, particularly in the latter mode, where only
one row is placed on a flag, must be hand-hoed in the inter-
vals, which should be done the first time in the begining of
the above month, and a second time towards the end of
it, or a little later. Some likewise do it to the broad-cast
wheats, but this has been supponed injurious by many.
The bushels of thilling the wheat-crops should also be
carefully performed in May, or in the very early part of
the following month, in all cafes where it may be necelfary.
The practice of rolling should also be employed without
either having recourse to the harrow, or after it has been
ufed, being highly benefical where the surface is cloddy,
and the operation is executed when the ground possesses
a medium degree of moiture, as well by forcing the roots of
the wheat into the earth, as by cauing the new items to
rise. And in thin light foils, when this fort of grain is
cultivated upon them, much benefit may also be produced in
this way, by the roots of the plants being prevented from
being fo eafily loofened and thrown out of the ground.
And the fame practice is recommended as generally ufeful
by fome where clover or gafes-feeds are fown with wheats-
crops, as a means of rendering the vegetation more fecure
and perfed.

In Berkshire, wheat-crops by the belt farmers are hoed
every where, and sometimes hand-weeded, the former on
frong foils often twice.

By good cultivators in some parts of Oxfordshire, too,
all the wheat-crops are hand-hoed in February or March,
and weeded afterwards.

And in Suffex, the practice most commonly adopted is
to hand-hoe wheat in the spring, sometimes only once, but
frequently twice, as the nature of the preceding crop may
have been. By fome, however, hand-hoeing wheat is dif-
approved of; they never hoe white corn, having given it
up, from a conviction that the crops were never benefited by
the practice; but, on the contrary, that mischief was
always done by it. On which, it is obferved, that fhould
the practice fometimes be right, and fometimes wrong; or
right on fome foils, and wrong on others, thofe contrary
facts may probably depend on the fpring roots, which
are faid to strike into the air, and enter the ground at
fome fmall distance from the item. If a hand-hoeing be
given juft before the appearance of thofe roots, it may, on
a bounden surface, prepare for their easy entrance; but
if given afterwards, it is probable the effeét would be mis-
chievous, would retard the progresfs of the plant, and force
it to do its work over again, perhaps at a worse feaIon. If
this be the cafe, the benefit which results from hitting
the time exactly, may by no means equal the probability of
mifchief upon a fcale of any extent; in which the right
time can fcarcely be taken for the whole of a crop. It has
been heard declared, too, by excellent farmers, that if a
perfon would pay for the hoeing of their wheat, they would
not permit the operation, being convinced that it does more
harm than good.

It has also been recommended, in fuch cafes where the
land is not in a fufficient flate of fertility or preparation to
bring the crops to perfection, to make use of top-dreflings.
Sublubes of both the solid and fluid kinds have been made
ufe of for this pofpose; the firft fectified of the dungs of
differt forts of birds, after being brought into a powdery flate, bone-dift, foot, peat-ashes, and various
faltine matters. The latter are principally the drainings of
dung-hills, and other fimilar liquid materials. The former
should be thinly fown over the crops with as much evennes
as po feasible, as early in the fpring as horfes can be admitted
upon the land without injury; and if it can be done when
the weather is inclined to be moif, it is the better; a roller
may then be paffed over the crop with advantage. Where
the latter sublubes are made ufe of, care should always be
taken that the plants be not injured by having too large a
quantity applied to them. In this practice, the expence
should be a primary confideration, and fmall trials firft made
where dungs are not to be ufed. The proper feaon for
performing the bufines is the beginning of February. See
Manure, and Top-Drefling.

It has been fuggested, too, that the method of transplan-
ting wheat may be had recourse to in particular cafes, with
beneficial confequences, as where there are fome parts of
fuch crops too thickly fet upon the ground, while others
are too thin, irregular, or patchy; as by thinning and set-
ing out the plants of fuch overabundant parts, among
thofe that are deficient, much service may be done to each of
them. The firft will be rendered more capable of admitt-
ing the operation of the hoe, and thereby of supplying
more abundant nourifhment for the luxuriant vegetation of
the plants, and the latter be supplied with the proper num-
er of plants, which could not be accomplished in any other
way. And it has been itated, that when raifed in the gar-
den, one acre would be capable of affording fets for an
hundred, when planted, after being properly divided at the
difance of nine inches from each other; and that as the
bufines of tranplanting is to be performed in the fpring,
it is fuppofed that crops of this grain may be raifed in this
manner on lands that poifefs a greater degree of moiture
than is fitted to the healthy growth of wheat in general.
Besides, clean crops may be produced in this way with
much greater certainty, as where the ground is ploughed
over juft before the plants are fet out, the grain may rife
much quicker from the plants than the weeds from their
seeds, and the crop in this way overpowcr fum noxious
plants. Advantages of other kinds have been itated by
different writers, as the refult of this mode of culting wheats-
crops. It is a practice, which, as well as that of Gribling,
has been had recourse to with fuccefs, both in Norfolk and
Eiflex.

The custom of feeding down wheat-crops, where too
forward or luxuriant in the early fpring months, by means
of fheep, is a practice that has been contended to be benefi-
cial in many cafes. The good effects, in fuch inftances,
according to Dr. Darwin, are fuppofed to arife from the
removal of the upright central item, by which means dif-
ferent new lateral items or root scions are fent off or
brought
brought forward with more vigour, by the acquisition of a larger proportion of nutritious matter from the joints in consequence, that much otherwise have been exhausted in supporting the central items. It is, however, a method which has been found by experience to be the most useful on such strong and fertile lands as are apt to produce a larger proportion of straw than can be properly supported. In which cases, advantage has been said to be derived by feeding off the blade at two or more successive times; but in effecting the business, great care is necessary to see that the whole is completed before the crop begins to spinle, otherwise more injury than good may be produced. And on the lighter and poorer descriptions of soils, the practice must be employed with great caution, as on such lands the growth of the crop may be so retarded, as to become weak and spinly. Besides, on those lands where they are very light, and the crop's thin, injury may frequently be done by many of the plants being pulled up, on account of the clovene of the bite of the sheep. They should, therefore, never be suffer'd to remain upon the crops when the weather is wet, and the surface of the ground much loosened, or after sudden frosts and thaws; as in such cases much harm may be done by the plants being pulled up and destroyed.

The treading of the animals may, however, be of great service in all the light sorts of wheat-land, and where the crops are thin; as by it the earth will not be preflled more closely upon the roots of the plants, but the fexms in many instances forced into the ground and covered up, that new shoots will be fent off laterally, and the crops be thus rendered more full on the land. But where the fexms are very stiff and adhesive, the growth of the crops may be checked and retarded by the practice, and of course the shoots thus caufed become weak, affording only small ears and light grain. Observations and experiments have convinced a writer in the Bath Papers, that wheat ought not to be fed down with sheep, unless it be very rank in January; and that such crops should only be fed as were fown early. And it has been suggested, that though this practice has much similarity to that employed in gardemng, of stopping the growth of the main fexms of fome sorts of plants, as those of the cucumber and melon kinds, by rubbing off or cutting away the central buds, in order to expedite their fruiting; yet in wheat-crops, where the principal items are eaten down, except when they are early, and of very luxuriant growth, the ears of the new shoots may not have time to perfect the feed, and of course become light and thrivell'd in the grain, and the new fexms from their weaknesses be more apt to fall down and be lodged. These are circumstances that have been frequently observed to occur by Mr. Tull, in the feeding down of wheat-crops by means of sheep. And that the fame philosophical obfERVER fupposes, that in the culture of wheat-crops, the most beneficial method is that of promoting, as much as possible, the time of bloflomming, while that of ripening is protracted, as it is for the farinaceous revoorv of nourishment, deposited in the cotyledon of the new seed, in order to support the growth of the corculum, or fresh embryo, that the plant is cultivated; which farinaceous deposition is effected in the interval between the bloflomming and ripening of the corn, either before the impregnation of the pericarp or seed-veffel, or afterwards; and the weight and plumpnefs of the rain are thus augmented.

The practice of feeding down young wheats by sheep may, therefore, be often hurtful, by retarding the period of bloflomming, as well as by restricting the growth of the items of the wheat-plants.

Sheep have likewise been employed on young wheat-crops in other views, as it has been remarked, that as the coronal parts of the roots of such crops are liable to be laid bare and expose'd for some inches in length about the surface of the earth, during severe frosty winters, the turning in sheep upon them in such circumstances when the ground is moist, and keeping them in motion, may tend to press them into the loose foil, and in that way produce new roots, as well as afford covering and protection to such as have been denuded. And, it is added, that some farmers who contend that much advantage is derived from it, turn sheep upon the crops where danger is apprehended from worms, fogs, and other insects; in order that by keeping them constantly in motion, such animals may either be wholly destroyed, or so fixed in the surface mould as to cause their more gradual death. There is a very great variety of these animals, which are suppos'd injurious to wheat as well as other crops; and for the destruction of which, lime, foot, and other faine matters, have been had recourse to with suppos'd advantage. See GRUB, SOOT, &c.

Wheat-crops are suppos'd to be much injured from different ferts of vegetable diseases, as the Blight, Blaff, Mildeuw, Snut, &c. See these different heads.

In the Ellif Report it is mention'd, that a disease which had not before been notice'd or heard of, was met with at Copdock in that district, which is call'd the purdey. The ears affected are perceive'd at once by their colour, a dirty brown mixed with green, as if part were ripe, with some chfts quite green; they feel nearly, but not quite, like blighted or abortive ears, which are brown, while the ears in general of the crop are of a bright red or white; when rubbed in the hand, as if to get the grain, no wheat is found, but apparently the small grains of a flattened indented globular form, and of a darkish purple, greenish or dark hue. It has not the smallest resemblance in appearance or fcent to smutty grains or bladders, and is certainly a distinct distemper. In many of these purpled ears are found some grains of good wheat. In order to discover if all the ears from the same root were affected on trial, in many instances they were found all similar from every root. It is very singular that no account that is recollect'd should have been given of such a strange malady, and so distinct from all others. Smutty ears were found in the same field, under all the common circumstances of that distemper. In Kent, it is faid, this distemper is call'd cockle-ear'd.

It has likewise been notice'd, that particular flutes of the weather have considerable influence on wheat-crops, at particular periods of their growth. As when the feaon is sufficiently dry, there is seldom much injury done to them during the winter months, however severe they may be in other respects, nor in throttle of the summer, provided the weather is not too moist about the time of bloflomming, as where that is the cafe the crops are moftly deficient in their produce.

And several sorts of weeds are injurious to wheat-crops, where they have been fown upon lands in an imperfect state of preparation, as charlock on the light calcareous foils; the corn poppy, on thole of the chalky kind, as well as cockle, oxalis-darling, puckweed, and couch; likewise roll's foot on the rather heavy kinds of lands. See these different heads, and Weed and Weeding.

This fort of crop is fhewn to be ripe and ready for the reaper by its fraw turning of a yellow colour, its ears beginning to bend in the neck and hang down, there being no greenens in the middle of them, and the grain becoming hard and plump. It is remarke'd, in the Ellif Report on Agricul-
Agriculture, that some do not like to cut wheat green, except it be the American white, which is brittle, and must be cut early, to prevent a lot of ears. It rarely lays. In Rochford hundred they do not cut till the wheat is ripe; but some few reap while it is yet green. It is, however, observed by a good farmer, that most rough chaff wheats, if they do not stand till fully ripe, will not thresh well.

It is flatted, too, in the Norfolk Report on Agriculture, that Mr. Parmenter, miller at Ayleham, a considerable farmer also, and a very intelligent man, remarked that the farmers let their wheat stand too long before cutting. They are apt to have a notion, that when millers give this opinion, it is speaking for their own interest; but he cuts his own wheat before it is ripe, and would do so on the largest scale, if he was not a miller. The quality is far superior, and the corn just as good. And Mr. M. Hill prefers cutting green, and never yet commenced harvest but he withheld he had begun three days sooner.

In the first of these Reports on Agriculture, a practice termed flagging is noticed as being for the first time met with. When the wheat-crops are very heavy, with broad luxuriant leaves, men with sickles move regularly through it, strike off many of them, for lightening the top, as a preservative against being beaten down by rain. It should be done carefully, or damage may ensue. See Reaping, Harvesting of Grain, Stacking, and Threshing.

Produce.—In respect to the quantity of wheat produced upon an acre, it must vary considerably, according to the circumstances of soil and preparation, as well as the state of the feaon; for it has been found that in some years the yield is under twenty, while in others it is upwards of thirty bushels the acre, the foil and culture being in every respect the same. And the average return of this crop throughout the whole of the kingdom, is probably not more than from three to three and a half quarters. And Mr. Donaldson has, indeed, flatted it at not more than three quarters the acre. The greatest crop of wheat, of which the author of the Report on Agriculture for Middlesex has any account, is, it is observed, sixty-eight bushels per acre; the least about twelve. The medium between these extremes is forty, which, it is conceived, would be the average of land highly cultivated. But the average produce of Britain does not, it is imagined, exceed one-half of this quantity, and yet, it is thought, that wheat is as certain a crop as any that is cultivated. It is observed, that the yield of several years varies the proportion which wheat bears to the flax in a very great degree, but that the average is about twelve bushels of wheat to each load of flax, weighing eleven hundred weight two quarters and eight pounds. It has been asserted, and probably with truth, that the flax of autumnal-fown wheat is more harsh, and less agreeable to cattle, than the flax of that which is fown in the spring. The weight of wheat by the bushel differs very much in different cases; but in most frowning land districts it is usually about sixty-two or three pounds to that quantity.

The yield of wheat is the greatest at the time of reaping, and becomes successively less and less the longer it is kept, so as ultimately, in many cases, to be a disadvantage to the farmer of not less than nearly one shilling in the bushel.

It may be noticed, that it is necessary, with the view of ascertaining the goodness of a sample of wheat, to determine by the eye whether the berry be perfectly fed or full, plump and bright, and whether there be any adulteration proceeding from sprouted grains, smut, or the seeds of weeds; and by the smell, whether there be any improper impregnation, and whether it has been too much heated in the mow or upon the kiln; and finally by the feel to decide if the grain be sufficiently dry, as when much loaded with moisture, it is improper for the use of the miller and baker. In cases where a sample handles coarse, rough, and does not slip readily in the hand, it may be concluded not to be in a condition either for grinding or laying up for keeping.

Wheat is usually sold by the farmers for being made into flour; and, in some cases, as feed-wheat for other districts, which is very advantageous, as the price in that way is mostly higher. The dealers, who convert it into flour, dispose of that to the different consumers, and the refuse part, as the pollard, to other persons for the food of horses, sheep, hogs, and other animals.

Wheat, Brining of; See Brining.

Wheat, Broyle, that sort of wheat-crop which is grown after oats, barley, or any other such kinds of grain, on light soils of the sandy and other similar sorts.

Broil-wheat crops are common in many of the more northern parts of this country, but the practice of putting wheat-crops in, in this way, is by no means to be much recommended, as they seldom answer any great purpose.

Wheat, Buck. See Buck-Wheat.

Wheat, Buck, in Botany. See Polygonum Fago-

Wheat, Cow, in Botany and Agriculture. See Mel-

Wheat, Cropping of; the practice of putting into the soil in fowing two different sorts of this grain of good qualities, in order to raise a new variety of a hill better kind. The practice of cropping in this manner has been found to answer perfectly, not only in this case, but in those of peas, apples, trees, &c. by Mr. Knight. In his trials, in years when almost the whole wheat-crops of the country were blighted, the varieties procured by croffing alone escaped, though raised on different sorts of land, and in very different situations and circumstances. See Seed, and Varieties.

Wheat, Fallow, that sort of complete naked fallow on which wheat is sown. See Fallow, and Fallowino.

Wheat, Grafs, a sort of grazes met with in land of some kinds. In the trials made on grasses at Woburn, the qualities of it stand as below.

From a rich sandy loam, the produce at the time of flowering was on the acre

<table>
<thead>
<tr>
<th>Oz.</th>
<th>Lbs.</th>
<th>Qt.</th>
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<tbody>
<tr>
<td>196020</td>
<td>12251</td>
<td>4</td>
</tr>
</tbody>
</table>

Weight of the grafs when dry

78408 = 4900 8

Weight loft by the produce of the land in nutritive matter

7350 12

The produce of the land in nutritive matter

7657 = 478 9

In the creeping rooted wheat-grass, the produce from a light clayey loam, at the time of flowering, was on the acre

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<tr>
<th>Oz.</th>
<th>Lbs.</th>
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<td>196020</td>
<td>12251</td>
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</tbody>
</table>

Weight of the grafs raised on the land in nutritive matter

78408 = 4900 8

Weight loft by the produce of the land in nutritive matter

7850 12

The fame extent of land afforded in nutritive matter

612510 = 38213 10

Sixty-four drachms of the roots afforded of nutritive matter 5.5 dr. The proportional value of the roots is therefore to that of the grafs, as 23 to 8.

Wheat, Grinding and converting of, into Flour, &c., the art and means of reducing it into this state, in which there are much nicety and difficulty in some cases, especially with the thinner-skinned sorts of this grain.

It
It is stated by the writer of the work on Agricultural Chemistry, that in this country the difficulty of grinding thin-skinned wheat is in some measure an objection; but that this difficulty is easily overcome by moistening the corn. And on the authority of John Jeffery, esq., the consul-general at Lisbon, the following observations on the subject are given, as transmitted by Dr Joseph Banks. In order to grind hard corn of this sort with the mill-stones used in this country, the wheat must be well screened, then sprinkled with water at the Miller's discretion, and laid in heaps, being frequently turned and thoroughly mixed together, which will soften the hulk so as to make it separate from the flour in grinding, and, of course, give the flour a brighter colour; otherwise the flinty quality of the wheat, and the thinness of the klin, will prevent its separation, and will render the flour unfit for making into bread.

The writer has been informed by a miller of considerable experience, and who works his mills entirely with the flones from this country or Ireland, that he frequently prepares the hard Barbaric corn of this kind by immersing it in water in close wicker baskets, and then spreading it thinly on a floor to dry; much depends on the judgment and skill of the miller in preparing the corn for the mill according to its relative quality. It is observed, however, that it is not from this previous process of wetting the corn that the weight in the flour of hard corn is increased; but from its natural quality it imbibes considerably more water in making it into bread. The mill-stones must not be cut too deep, but the furrows very fine, and picked in the usual way.

The mills should work with less velocity in grinding hard corn than with soft, and be let to work at first with soft corn, until the mill ceases to work well; then put on the hard corn. Hard wheat always sells at a higher price in the market than soft wheat, on an average of from ten to fifteen per cent.; as it produces more flour in proportion, and less bran than the soft corn.

 Flour made from hard wheat is more esteemed than what is made from soft corn; and both sorts are applied to every purpose.

The flour of hard wheat is in general superior to that made from soft; and there is no difference in the processes of making them into bread: but the flour from hard wheat will imbibe and retain more water in making into bread, and will consequently produce more weight of bread. It is the practice in Lisbon, and which is thought would be advisable to adopt in this country, to make bread with flour of hard and soft wheat, which, by being mixed, will make the bread much better. As the most flinty wheats are capable of being readily and easily ground by these means, much advantage may arise from the mixing of the flour of the thin-skinned wheats with those of the thicker-skinned kinds in the forming of bread, as well as in preventing the objections to the cultivation and growth of the former, on account of their flinty quality, and grinding hard and with inconvenience. By these means many of the well-harvested and well-kept wheats of this country will be found to be equal to those of any other, for most purposes to which the flour is usually put. See Spring-Wheat, and Wheat. Also Vegetables.

In the Middlesex Corrected Report on Agriculture, it is stated, that the best flour is mostly used by the pastry-cooks, and the makers of fine biscuits, and the inferior sorts in the making of bread. These have often the worst kinds of damaged foreign wheats, and other materials, mixed with them in grinding them into flour. And that, if the bread confounded in the metropolis was prepared from the wheat of this country, unmixed with the leaner produce of other nations, the trial detailed below would shew with accuracy the quantity of bread that could be made from a Winchester bushel of that grain.

One bushel of the wheat of this country, which weighed sixty-one pounds, was taken. It was then ground, and the meal weighed 60\$ lbs.; which, on being dried, produced 46\$ lbs. of flour, of the first called seconds, which alone is used for the making of bread throughout the greater part of this country; and of flour and bran \(12\frac{1}{2}\) lbs., which quantity was boiled, and it produced in flour \(3\frac{1}{2}\) lbs., which being sifted produced in good second flour \(1\frac{1}{2}\) lb.

The whole quantity of bread-flour obtained from the

<table>
<thead>
<tr>
<th>bushel of wheat, weighed</th>
<th>lbs.</th>
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<tbody>
<tr>
<td>Fine pollard</td>
<td>48</td>
</tr>
<tr>
<td>Coarse pollard</td>
<td>4</td>
</tr>
<tr>
<td>Bran</td>
<td>2(\frac{1}{2})</td>
</tr>
</tbody>
</table>

| The whole together      | 59  |

<table>
<thead>
<tr>
<th>To which add the loss of weight in manufacturing</th>
</tr>
</thead>
<tbody>
<tr>
<td>the bushel of wheat</td>
</tr>
<tr>
<td>---------------------------------------</td>
</tr>
<tr>
<td>flour</td>
</tr>
</tbody>
</table>

| Produces the original weight         | 61  |

The lack of marketable flour is by law obliged to weigh 240 lbs., which is exactly the produce of five bushels of such wheat; and the lack of flour is constantly supposed to make eighty quarter loaves of bread; and consequently sixteenths of such loaves are made from each bushel of such wheat. It is admitted, however, that two or three loaves more than the above quantity can be made from the lack of flour, when it is the genuine produce of good wheat; that is, in the proportion of about sixteen and a half loaves from each bushel of good grain; and, it may be prefixed, sixteen from a bushel of medium corn. The expense of making the lack of flour into bread, and disposing of it, is about 8s.

WHEAT, Indian. See MAIZE.

WHEAT, Mildew in. See MILDEW.

WHEAT, Mylt of. See MILD.

WHEAT, Rust. See STADDLE, and STAND.

WHEAT, Root. See STADDLE, and STAND.

WHEAT, Rust in. See RUST.

WHEAT-Seed, Liming of, the practice of drying moistened corn of this sort by means of powdery limestone. It is the custom in some places to make it wet over-night, with salt or other water, and to dust it over with the lime the next morning before it is sown, mixing it well together in the operation. By the lime, however, thus remaining for a short time on the grain before sowing, it has no time to penetrate into
into the corn; whereas, by moistening the wheat, and leaving it until the succeeding morning well limed, the lime has a greater power, it is supposed, in destroying the flmutpowder, than when it remains on it only for half an hour, and is then moister rubbed off the corn. Half a bushel of the strongest lime is sufficient for a quarter of wheat, when sifted over and mixed well with it.

In this last mode of drying feed-wheat, with lime, it is found to be very efficient in preventing the crops from being diseased in some districts. See Steeping Seed.

As there is uncertainty whether the effect in this practice is to be ascribed to the washing of the grain or the lime, some merely moisten the corn for the purpose of making the lime adhere to it; while others are extremely attentive to the liquor made use of and the washing of the feed, and simply make use of the lime for drying it for feeding. Lime is, however, considered as a great preventative of disease in the grain by many. It should always be used while fresh and newly flattened.

Wheat, Setting off, the practice of putting it into the soil by the hand. In many parts of the vale of the county of Gloucester, they set wheat by the hand and line; but the difficulty of getting on with the work at the proper season, when on a large scale, in consequence of the want of hands, operates against the more general introduction of this practice. When wheat is set by the hand in this way, not more than three pecks of seed are made use of. On clover-leys wheat is often put in by the hand in small channels made across the beds, which have been formed by the plough to the width of half a ley, dropping the seed into them, and leaving a distance of about seven inches between the different channels. This mode is said to be good for late work; and the expense to be about seven shillings the acre, the seed being usually about six pecks. In some other districts the setting of wheat is said to be practised with much success and advantage; but it is probably too tedious and expensive a mode to be had recourse to on any large extent of wheat cultivation. See Dibbling, and Setting of Wheat.


Wheat, Smyrna, a peculiar kind of wheat that has an extremely large ear, with many lesser or collateral ears coming all round the bottom of the great one.

As this is the largest of all sorts of wheat, so it will diffuse with the nourishment of a garden, without being overfed, and requires more nourishment than common husbandry in the large way can give it. In the common way its ears grow not much larger than those of our common wheat.

This sort of wheat feeds, of all others, the most proper for the new method of horse-hoeing husbandry, as that method feeds capable of giving as much nourishment as the farmer pleases, by often repeating the hoeing. Next to this, the white-cone wheat is best for this sort of husbandry; then the grey-cone wheat.

Wheat-Stubble, Cutting and Collecting of, the useful practice of mowing and raking together the strong stubbles of wheat-crops, and flacking them up in or near the farmyards as additional litter, and for other purposes. It should always be done as soon as possible after the wheat has been taken from the fields. See Stubble.

Wheat, Tillering of, the throwing out of new shoots, items, or flarks, from about the roots, so as to increase the thickness of the crops on the grounds. It takes place much more extensively in the autumnal and winter grown wheats than those of the spring sowings. See Tiller, and Wheat.

Wheat, Transplantation of, the practice of putting into the ground the young plants of wheat that have been raised in other places, or which stand too thick on the land. It is observed in the Middlesex Report on Agriculture, that it is well calculated for increasing the quantity of corn produced from a single grain, and that it may be resorted to for the sake of curiosity when the cultivator has procured a small quantity of some new and very valuable variety of seed; but that a farmer should never extend it to his field culture.

There would be much loss in labour and in other ways, it is supposes, by this practice, and nothing be gained by it. See Transplanting, and Wheat.

Wheat, White-cone, a term used by our husbandmen, to express a peculiar kind of wheat, which is very strong, and has a large ear.

It is the best kind for sowing in fields subject to the blight; for the flarks of it being, for the most part, solid or full of pith, like a rush, not hollow, like those of common wheat; the infects that cause the blight, fothing on the flarks of other wheat, do this no injury, even though they should attack it; the flarks of this kind being often found full of the black specks, which are always the marks of that infect, having been there, and yet the ear full, and the grain good.

This wheat makes very good bread, if the miller does not grind it too small, or the baker make his dough too hard, it requiring to be somewhat larger than other wheat-flour, and somewhats softer in the dough. A bushel of white-cone wheat will make considerably more bread than a bushel of Lammas wheat; but it gives it a somewhat yellowish cast.

Wheat-Bird, in Ornithology, a name given by the people of Virginia to a species of bird, which, after the time of the sowing of the wheat in that country, made its appearance annually at the feast of its beginning to ripen, and was never seen there before. See Migration of Birds.

Wheat-Ear, the English name of the common eanthe, or ovata eanthe of Linnæus, called also the white-tail, and the falloven-finch. See MTACILLA EANTHE.

WHEATEN-BREAD. See Theory of Bread, and Wheat, Grinding of, &c.

WHEATFIELD, in Geography, a township of Pennsylvania, in the county of Indiana, with 1475 inhabitants.

WHEATLY, FRANCIS, in Biography, was born in London in 1747, and received his first instruction as an artist in Shipley's drawing-school. Whilst young he received several premiums from the Society for the Encouragement of Arts, &c. He does not appear to have had any particular instructor in painting, but by his own industry and ingenuity contrived to obtain some knowledge of it; and having formed an intimacy with Mr. Mortimer, whom he assisted in painting the ceiling at Brockett Hall, by that circumstance obtained considerable improvements. He had great employment in painting small whole-length portraits, to which he added landscape back-grounds with considerable taste. After practising some years in London, he went to Ireland, and was much employed in Dublin, where he painted a large picture of the Irish house of commons, with portraits of the most considerable political characters, by which he acquired great reputation. On his return to London he painted a picture of the foldery attacking the rioters in 1785, which was well engraved by Heath.

About this time he appears to have changed his practice, and painted rural and domestic subjects in a manner which evidently exhibits them to have been the offspring of the natural bent of his mind. He was engaged in the Shakespeare Gallery, but failed to excite interest; neither his talent nor his style was suited to the character of the subjects given to him. In the lighter subjects of common life he was at home, and he touched them and composed them in a most agreeable manner, and with a very pleasing tone of colour;
Whee, Whey, Whee, or Qui, in Rural Economy, a term used to signify a young heifer, or heifer-calf, in different places and parts of the country.

Wheang, or Wiang, a provincial term made use of to signify a thong or strap of leather for the harness or gear of farm-teams, or other domestic purposes.

Wheel, Rota, in Mechanics, a simple machine, consisting of a round piece of wood, metal, or other matter, which revolves on an axis.

For an account of the wheel and axis, as a mechanical power, see Axis in Peritrochio, and Mechanical Powers.

The wheel is one of the principal mechanic powers. It has place in most engines; in effect, it is of an assemblage of wheels that most of our chief engines are composed. Windmills, mills, &c.

Its form is various, according to the motion it is to have, and the use it is to answer. By this it is distinguished into simple and dented.

Wheels, Simple, are those whose circumference and axis are uniform, and which are used singly, and not combined. Such are the wheels of carriages, which are to have a double motion; the one circular about their axis, the other rectilinear, by which they advance along the road, &c. in which two motions they appear to have; though, in effect, they have but one; it being impossible the fame thing should move, or be agitated, two different ways at the same time.

This one is a spiral motion; as easily seen, by fixing a piece of chalk on the face of a wheel, so as that it may draw a line on a wall, as the wheel moves. The line it here traces is a just spiral, and still the more curve, as the chalk is fixed nearer the axis.

The fact, however, has been disputed; and it has been alleged, that nothing is more easy than for any one, who will take the trouble to make the experiment, to prove its falsehood. Place the chalk on the face of the wheel, as directed, and you will find that, so far from its describing a just spiral, and still the more curve as the chalk is fixed nearer the axis, the chalk, if placed on the periphery of the wheel, will describe a cycloid, and the nearer it is placed to the axis, the nearer will the line it describes approach to the straight line which is described by the axis itself. Moreover, it is not true, nor pretended to be so, that the same thing moves two ways at once in the rectilinear and circular motion of wheels. The local motion, or motion of the whole wheel, is rectilinear only; that of the parts of the wheel circular. Nor can this latter motion with any propriety be called that of the wheel, unless the same thing could also move quick and flow at the same time, which the different parts of the wheel, in revolving round its axis, evidently do. Jacob's Obf. on the Structure and Draught of Wheel-Carriages, 1773, p. 28, &c.

For a very nice phenomenon, in the motion of these wheels, see Rota Aristotelia.

We shall add, that, in wheels of this kind, the height should always be proportioned to the nature of the animal that draws or moves them. The rule is, that the load and the axis of the wheels be of the same height with the power that moves them; otherwise the axis being higher than the beast, part of the load will lie upon him; or, if it be lower, he pulls to disadvantage, and must exert a greater force. Though Stevinus, Dr. Wallis, &c. shew, that, to draw a vehicle, &c. over wide uneven places, it were best to fix the traces to the wheels somewhat lower than the horse's breast. See Wheels of Coachers, &c.

The power of these wheels results from the differences of the radii of the axis, and circumference. The canon is this: "As the radius of the axis is to that of the circumference, so is any power to the weight it can sustain hereby."

This is also the rule in the axis in peritrochio; and, in effect, the wheel, and the axis in peritrochio, are the same thing; only, in theory, it is usually called by the latter name, and in practice by the former.

Wheels, Dented, are those either whose circumference, or axis, is cut into teeth, by which they are capable of moving and acting on one another, and of being combined together.

The use of these is very conspicuous in clocks, jacks, &c.

The power of the dented wheel depends on the same principle as that of the simple one. It is only that the simple axis in peritrochio, which a compound lever is to a simple lever.

Its doctrine is comprised in the following canon; viz., "The ratio of the power to the weight," in order for that to be equivalent to this, "must be compounded of the ratios of the diameter of the axis of the lathe wheel to the diameter of the first; and of the ratio of the number of revolutions of the last wheel, to those of the first, in the same time." But this doctrine will deserve a more particular explanation.

1. Then, if the weight be multiplied into the product of the radii of the axes, and that product be divided by the product of the radii of the wheels, the power required to sustain the weight will be found. Suppose, e. gr. the weight A (Plate XL., fig. 52, Mechanics,) = 6000 pounds, B C = 6 inches, C D = 34 inches, E F = 5 inches, E G = 35 inches, H I = 4 inches, H K = 27 inches; then will B C X E F X H I = 1201; and C D X E G X H K = 32130. Hence the power required to sustain the weight, will be 6000 X 1201 32130 = 22+ very nearly; a small addition to which will raise it.

2. If the power be multiplied into the product of the radii of the wheels, and the quotient be divided by the product of the radii of the axes, the quotient will be the weight which the power is able to sustain. Thus, if the power be 22+ pounds; the weight will be 6000 pounds.

3. A power and weight being given, to find the number of wheels, and in each wheel the ratio of the radius of the axis, to the radius of the wheel; so as that the power, being applied perpendicularly to the periphery of the lathe wheel, may sustain the given weight.

Divide the weight by the power; resolve the quotient into the factors which produce it. Then will the number of factors be the number of wheels; and the radii of the axis will be to the radii of the wheels, as unity to the several wheels. Suppose, e. gr. a weight of 3000 pounds, and a power of 60, the quotient of the former by the latter is 500, which resolves into these factors, 4, 5, 5, 5. Four wheels are, therefore, to be made; in one of which, the radius of the axis is to the radius of the wheel, as 1 to 4; in the rest, as 1 to 5.

4. If a power move a weight by means of two wheels, the revolutions of the lower wheel are tho' of the swifter, as the periphery of the swifter axis is to the periphery of the wheel that catches on it.

Hence, r. The revolutions are as the radius of the axis FE to the radius of the wheel DC. 2. Since the num-
ber of teeth in the axis $F$ is to the number of teeth in the circumference of the wheel $M$, as the circumference of that to the circumference of this; the revolutions of the flower wheel $M$, are to the revolutions of the swiftest $N$, as the number of teeth in the axis to the number of teeth in the wheel $M$, which it catches.

5. If the factum of the radii of the wheels $G$ $E$, $D$ $C$, be multiplied into the number of revolutions of the flowest wheel, $M$, and the product be divided by the factum of the radii of the axes which catch into them, $G$ $H$, $D$ $E$, &c. the quotient will be the number of revolutions of the swiftest wheel $O$. $E$ gr. If $G = 8$, $D = 1$, $G = 4$, $D = 1$, and the revolution of the wheel $M$ be 1; the number of revolutions of the wheel $O$ will be 8.

6. If a power move a weight by means of divers wheels, the space passed over by the weight, is to the space of the power, as the power to the weight. Hence, the greater the power, the quicker is the weight moved; and vice versa.

7. The spaces passed over by the weight and the power, are in a ratio compounded of the revolutions of the flowest wheel, to the revolution of the swiftest; and of the periphery of the axis of that, to the periphery of this. Hence, since the spaces of the weight and the power are reciprocally as the sustaining power is to the weight; the power that sustains a weight will be to the weight, in a ratio compounded of the revolutions of the flowest wheel, to that of the swiftest, and of the periphery of the axis of that, to the periphery of this.

8. The periphery of the axis of the flowest wheel, with the periphery of the swiftest wheel, being given; as also the ratio of the revolutions of the one, to those of the other; to find the space which the power is to pass over, while the weight goes any given length. Multiply the periphery of the axis of the flowest wheel into the antecedent term of the ratio, and the periphery of the swiftest wheel into the consequent term; and to these two products, and the given space of the weight, find a fourth proportional: this will be the space of the power. Suppose, $e$.gr. the ratio of the revolutions of the flowest wheel, to those of the swiftest, to be as 2 to 3, and the space of the weight 30 feet; and let the periphery of the axis of the flowest wheel be to that of the swiftest, as 3 to 8: the space of the power will be found 280. For $2 \times 3 = 7 \times 3 = 210$.

9. The ratio of the peripheries of the swiftest wheel, and of the axis of the flowest; together with the ratio of their revolutions, and the weight, being given: to find the power able to sustain it. Multiply both the antecedents and the consequents of the given ratios into each other, and to the product of the antecedents, the product of the consequents, and the given weight, find a fourth proportional: that will be the power required. Suppose, $e$.gr. the ratio of the peripheries $8 : 3$, that of the revolutions $7 : 2$, and the weight 2000; the power will be found 2148. For $7 \times 8 \times 3 = 2000 \times 2148$. After the same manner may the weight be found; the power, and the ratio of the peripheries, &c. being given.

10. The revolutions the swiftest wheel is to perform while the flowest makes one revolution, being given; together with the space the weight is to be raised, and the periphery of the flowest wheel; to find the time that will be spent in raising it.

Say, As the periphery of the axis of the flowest wheel is to the given space of the weight; so is the given number of revolutions of the swiftest wheel to a fourth proportional:

Vol. XXXVIII.
wheels would be useful only in overcoming friction; but as they are drawn along roads covered with loose stones, indented with cavities, they are farther useful in serving to depref, or raise the carriage over the one, and in raising it out of the other.

2. The wheels of all carriages ought to be exactly round; and the fellettes should be at right angles to the naves, according to the inclination of the spokes, i.e. the plane of the curvature of the wheel should cut the nave at right angles, though it need not pass through the place where the spokes are intersected into the nave.

3. The spokes, according to Mr. Ferguson and most other writers on mechanics, should be inclined to the naves, so that the wheels may be diving or concave. If, indeed, the wheels were always to go upon smooth and level ground, it would be best to make the spokes perpendicular to the naves, or at right angles with the axes; because they would then bear the weight of the load perpendicularly, which is the strongest way for the wood. But because the ground is generally uneven, one wheel often falls into a cavity or rut, when the other does not, and then it bears much more of the weight than the other does; in which case diving wheels are best, because the spokes become perpendicular to the rut, and therefore have the greatest strength when the obliquity of the road throws most of its weight upon them; whilst those on the high ground have less weight to bear, and therefore need not be at their full strength. Besides, by this form of the wheels, the base of the carriage is extended, and it is thus prevented from being easily overturned, and the fellettes are hindered from rubbing against the load or the sides of the cart. Dr. Brewer, however, is of opinion, that the disadvantages of concave wheels overbalance their advantages. Mr. Anville also, in his "Treatise on Wheel-Carriages," whilst he recommends concave wheels, candidly allows, that some disadvantages attend this construction of them; for the carriage thus takes up more room on the road, so that it is more unmanageable; and when it moves upon plane ground the spokes not only do not bear perpendicularly, by which means their strength is lessened, but the friction upon the nave and axle is made unequal, and so much the more as they are the more dished. Dr. Brewer farther shews, that they are more expensive, more injurious to the roads, more liable to be broken by accidents, and less durable in general, than those wheels in which the spokes are perpendicular to the naves. From these and other considerations, our author is decidedly of opinion, that if wheels are to be compos'd of naves, spokes, and fellettes, the rim should be cylindrical, and the spokes perpendicular to the naves; whereas in concave wheels, the rims are uniformly made conical, which subjects them to a variety of disadvantages. Every cone that is put in motion upon a plane surface will revolve round its vertex, and if force is employed to confine it to a straight line, the smaller parts of the cone will be dragged along the ground, and the friction greatly increased. Now when a cart moves upon conical wheels, one part of the cone rolls while the other is dragged along, and though confined to a rectilinear direction by external force, their natural tendency to revolve round their vertex occasions a great and continued friction upon the lynch-pin, the shoulder of the axle-tree, and the sides of deep ruts.

Dr. Brewer has made some farther observations on the construction of certain parts of the wheels. The iron plates, he says, of which the rims are compos'd, should never be less than three inches in breadth, as narrower rims sink deep into the ground, and therefore injure the roads and fatigue the horses. See the sequel of this article.

4. The axles of the wheels ought to be perfectly straight, and at right angles to the shafts, or to the pole. When the axles are straight, the rims of the wheels will be parallel to each other, and then they will move the easiest, because they will be at liberty to go on straight forwards. But in the usual way of practice, the axles are bent downwards at their ends; which brings the sides of the wheels next the ground nearer to one another than their higher sides are; and this not only makes the wheels to drag sideways as they go along, and gives the load a much greater power of crushing them than when they are parallel to each other, but also endangers the overturning of the carriage when any wheel falls into a hole or rut, or when the carriage goes on a road which has one side lower than the other, as along the side of a hill. Thus, in the hind view of a waggon or cart, let $A$ and $B$ (Plate XL. fig. 9. Mechanics) be the great wheels parallel to each other, on their straight axle $K$, and $C$ the carriage loaded with heavy goods from $C$ to $G$. Then as the carriage goes on in the oblique road $A$ to $B$, the centre of gravity of the whole machine and load will be at $C$; and the line of direction $C$ to $D$ falling within the wheel $B$, the carriage will not overturn. But if the wheels be inclined to each other at the ground, as $A$ and $B$ are (fig. 10.), and the machine be loaded as before from $C$ to $G$, the line of direction $C$ to $D$ falls without the wheel $B$, and the whole machine tumbles over. When it is loaded with heavy goods which lie low, it may travel safely upon an oblique road, so long as the centre of gravity is at $C$ (fig. 9.), and the line of direction $C$ to $D$ falls within the wheel; but if it be loaded high with lighter goods from $C$ to $L$ (fig. 11.), the centre of gravity is raised from $C$ to $K$, which shews the line of direction $K$ to $L$ without the lowest edge of the wheel $B$, and then the load overfalls the waggon. Mr. Beighton has offered several reasons to prove, that the axles of wheels ought not to be straight: for which we must refer to Delagiers' Exp. Phil. vol. ii. Appendix, p. 546. &c. Moreover, if the axle were not at right angles to the pole or shaft, but this was on one side, then the coach or carriage would be drawn on one side, and almost all the weight would bear upon one horse. With some mechanics, it is a practice to bend the ends of the axle-trees forwards, and thus make the wheels wider behind than before. Mr. H. Beighton maintains, that wheels in this position are more favorable for turning; since, when the wheels are parallel, the outer shoe would press against the lynch-pin, and the inner shoe would rub against the shoulder of the axe-tree. In rectilinear motions, however, these converging wheels occasion a great deal of friction, both on the axle and the ground, and must therefore be more disadvantageous than parallel ones. This fact is allowed by Mr. Beighton: but he seems to find his opinion upon this principle; that as the roads are seldom straight lines, the wheels should be more adapted to a curvilinear than to a rectilinear motion.

5. Large wheels are always more advantageous for rolling than small ones, in any case, or upon any ground whatever. If we consider wheels with regard to their friction upon the axles, it is evident, that small wheels must turn as much of the time round the large ones, as their circumferences are less; and, therefore, a wheel which is twice as large as another will have twice the advantage in respect of the friction, the holes of the naves and axles, and the weights upon them, being equal. Again, if we consider the wheels as they sink into the earth, or fall into holes, the bearing of the great wheel being double that of the small one, it would sink but half so deep; and if the small wheel should meet with a hole of the same diameter with itself, it would wholly sink in, whilst only a segment less than half of the great wheel
WHEEL.

wheel would fall in: the same thing would also happen in
marshy ground, where the small wheel would sink wholly in
the same hole which the great one would sink into but in part.
The large wheel would also have the advantage of a
small one in rising over eminences or rubs that occurred; for
that the former would go over rubs much higher than the
latter; and indeed over any eminences, provided their height
be not equal to its semidiameter. Defaguer has reduced
this matter to a mathematical calculation, in his Exp. Phil.
vol. i. p. 171, &c.

A late writer has also proved, that a wheel of eight feet
diameter has somewhat more than twice the advantage in
overcoming obstacles of a wheel of two feet; and he found,
in practice, that if it requires a certain power to draw a
carriage of a certain weight over a certain obstacle, with
wheels of any determinate diameter, it will require wheels
of four times that diameter, to draw the same carriage over
the same obstacle with half that power. This writer also
observes, that, in the draught of carriages ascending inclined
planes, the moving power acts not only against the vis in-
ertia, which is always equal to the absolute gravity of the
load, but also against its relative gravity, which increases
with the inclination of the plane; and with respect to car-
rriages raised on wheels, it is to be observed, that the higher
the axle is removed from the plane, the farther is the centre
of gravity removed out of the perpendicular line of sup-
port; so that the lower the wheel, the less is the relative
gravity of the carriage. Hence he infers, that supposing
the friction of two carriages of equal weight, but of dif-
f erent sized wheels, to be equal, the low-wheeled one would
be drawn up hill, on a smooth plane, much more easily
than the high-wheeled one; though on a smooth, horizontal
plane, the latter would be drawn more easily than the former.
On the contrary, in going down hill, the high-
wheeled carriage will be urged forward, by its relative gra-
vity, more than the low-wheeled one. Jacob, ubi supra,
p. 63, &c.

It appears, therefore, that the larger wheels are, the more
advantageous they are in proportion, provided that they are
not more than five or six feet in diameter; for when they ex-
ceed these dimensions, they become heavy; or if they are
made light, their strength is proportionably diminished, and
the spokes, being long, are more liable to break: besides,
horses applied to such wheels, would be incapable of exert-
ing their utmost strength, by having the axles higher than
their breasts, so that they would draw downwards; as in
small wheels the draught is made more difficult, by the
horses drawing upwards.

It is observed by Dr. Brewster, in the appendix to his
edition of “Ferguson’s Mechanics,” that when the wheels of
carriages either move upon a level surface, or overcome
obstacles which impede their progress, they act as mecha-
nical powers, and may be reduced to levers of the first kind.
In order to elucidate this remark, which is of great import-
ance in the present discussion, let A be the centre, and B C N
the circumference of a wheel 6 feet in diameter, and let the
impelling power P, which is attached to the extremity of a
rope A D P, pulling over the pulley D, act in the hori-
zontal direction A D. Then, if the wheel is not affected
by friction, it will be put in motion upon the level surface
M B, when the power P is infinitely small. For since the
whole weight of the wheel rests on the ground at the point B,
which is the fulcrum of the lever A B, the distance of the
weight from the centre of motion will be nothing, and there-
fore the mechanical energy of the smallest power P, acting
at the point A, with a length of lever A B, will be infi-

weight to be raised, and this will be the case, however small
the lever A B, and however great be the weight of the
wheel. But as the wheels of carriages are constantly meet-
ing with impediments, let C be an obstacle six inches high,
which the wheel is to surmount. Then the spoke C will
represent the lever, C its fulcrum, A D the direction of
the power; and if the wheel weighs 100 pounds, we may repre-
sent it by a weight W, fixed to the wheel’s centre A, or to
the extremity of the lever C A, and acting in the perpendi-
cular direction A B, in opposition to the power P. Now
the mechanical energy of the weight W to pull the lever
round its fulcrum in the direction A E, is represented by
C E, while the mechanical energy of an equal weight P
to pull it in the opposite direction A F, is represented by C F;
an equilibrium, therefore, will be produced, if the power P
is to the weight W as C E to C F, or as the line is to the co-
fine of an angle, whose vertex is equal to the height of
the ob stacle to be surmounted; for E B, the height of the
wheel C, is the verified sine of the angle B A C, and C E
is the sine, and C F the cosine of the same angle. In the
present case, where E B is six inches, and A B three feet,
E B, the verified sine, will be 1666, &c. when A B is 1000
and, consequently, the angle B A C will be 33° 33’, and
C E will be to E F, as 52 to 83, or as 66 to 100. A
weight P, therefore, of 66 pounds, acting in a horizontal
direction, will balance a wheel six feet diameter, and 100
pounds in weight, upon an obstacle six inches high; and a
small additional power will enable it to surmount that ob-
stacle. But if the direction, A D, of the power, be in-
clined to the horizon, so that the point D may rise towards
H, the line F C, which represents the mechanical energy of
P, will gradually increase, till D A has reached the po-
fition H A, perpendicular to A C, where its mechanical
energy, which is now a maximum, is represented by A C,
the radius of the wheel; and since E C is to C A as 53 to
1000, a little more than 53 pounds will be sufficient for
enabling the wheel to overcome the obstacle.

Proceeding in this way, it will be found, by our author, that
the power of wheels to surmount eminences increases with their
diameter, and is directly proportional to it, when their weight
remains the same, and when the direction of the power is
perpendicular to the lever which acts against the obstacle.
Hence we see the great advantages which are to be derived
from large wheels, and the disadvantages which attend small
ones. There are some circumstances, however, which con-
fine us within certain limits in the use of large wheels. When
the radius A B of the wheel is greater than D M, the height of
the pulley, or of that part of the horse to which the rope
or pole D A is attached, the direction of the power, or the
line of traction A D, will be oblique to the horizon as A d,
and the mechanical energy of the power will be only A c,
whereas it was represented by A E, when the line of trac-
tion was in the horizontal line D A. Whenever the radius
of the wheel, therefore, exceeds four feet and a half, the
height of that part of the horse to which the traces shoul
d be attached, the line of traction A D will incline to the
horizon, and by declining from the perpendicular A H, its
mechanical effort will be diminished; and since the load refts
upon an inclined plane, the trams or poles of the cart will
rub against the flanks of the horse, even in level roads, and
still more severely in defceeding ground. Notwithstanding
this diminution of force, however, arising from the un-
avoidable obliquity of the impelling power, wheels exceeding
four and a half feet radius have still the advantage of
smaller ones; but their power to overcome resistances does
not increase so fast as before. Hitherto we have suppos-

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it is evident that when we augment their diameter we add greatly to their weight; and by thus increasing the load, we febibly diminish their power.

From these remarks, we see the superiority of great wheels to small ones, and the particular circumstances which suggest the propriety of making the wheels of carriages less than four feet and a half radius. But even this size is too great; and it may be safely asserted that they should never exceed six feet in diameter, nor ever be less than three feet and a half.

6. Carriages with four wheels, as wagons or coaches, are much more advantageous than carriages with two wheels, as carts and chariots; for in applying horses to a carriage with two wheels, it is plain that the tier carries part of the weight, in whatsoever manner it be kept in equilibrium upon the axle. In going down a hill, the weight bears upon the horse; and in going up a hill, the weight falls the other way, and lifts the horse, by which means part of his force is lost.

Besides, as the wheels sink into the holes in the road, sometimes on one side, sometimes on the other, the shafts strike against the tier’s flanks, which is the destruction of many horses. Add to this, that when one of the wheels sinks into a hole or rut, half the weight will fall that way, whereby the carriage will be in danger of being overturned.

7. It would be much more advantageous to make the four wheels of a coach or wagon large, and nearly of a height, than to make the fore-wheels of only half the diameter of the hind-wheels, as usual in many places. The fore-wheels of carriages have commonly been made of a less size than the hind ones, both on account of turning short, and to avoid cutting the braces. Crane-necks have also been invented for turning yet shorter, and the fore-wheels have been lowered, so as to go quite under the bend of the crane-neck. See an account of an ingenious contrivance for this purpose, under Perch.

Some carriers and coachmen have, indeed, absurdly alleged, that when the fore-wheels are much lower than the hind ones, they serve to push them on. However, many disadvantages attend this construction. A considerable force is lost that would be effectual, if they were large; the carriage would go much more easily, if the fore-wheels were as high as the hind-ones; and the higher the better, because their motion would be so much the slower on their axles, and consequently the friction proportionately diminished. The jolting and uneasy motion occasioned by low wheels, has induced persons to contrive springs, in order to prevent it. But nothing can be more inconvenient, even with this end, than the common method of fixing the braces to the bottom of a carriage. In consequence of this practice, the centre of gravity of the suspended body is so high above the centre of its motion, that it is liable to be continually agitated by the jolting of the carriage, and its danger of overturning increased; whereas if, instead of practising this method, the body were suspended as near as possible to its centre of gravity, the agitation of the carriage, as well as its danger of overturning, would be in a great measure avoided.

The effect of the suspension of a carriage on springs is to equalize its motion, by causing every change to be more gradually communicated to it, by means of the flexibility of the springs, and by confining a certain portion of every sudden impulse in generating a degree of rotatory motion. This rotatory motion depends on the oblique position of the straps suspending the carriage, which prevents its swinging in a parallel direction; such a vibration as would take place if the straps were parallel, would be too extensive, unless they were very short, and then the motion would be some-what rougher. The obliquity of the straps tends also in some measure to retain the carriage in a horizontal position: for if they were parallel, both being vertical, the lower one would have to support the greater portion of the weight, at least according to the common mode of fixing them to the bottom of the carriage; the spring, therefore, being flexible, it would be still further depressed. But when the straps are oblique, the upper one assumes always the more vertical position, and consequently bears more of the load; for when a body of any kind is supported by two oblique forces, their horizontal thrusts must be equal, otherwise the body would move laterally; and in order that the horizontal portions of the forces may be equal, the more inclined to the horizon must be the greater: the upper spring will, therefore, be a little depressed, and the carriage will remain more nearly horizontal than if the springs were parallel. The reason for dividing the springs into separate plates has already been explained: the beam of the carriage, that unites the wheels, supplies the strength necessary for forming the communication between the axles: if the body of the carriage itself were to perform this office, the springs would require to be so strong that they could have little or no effect in equalizing the motion, and we should have a wagon instead of a coach.

The ease with which a carriage moves, depends not only on the elasticity of the springs, but also on the small degree of stability of the equilibrium, of which we may judge in some measure, by tracing the path which the centre of gravity must describe, when the carriage swings.

There is an inconvenience which attends the usual method of loading carriages; for when a carriage is loaded equally heavy on both axles, the fore-axle must endure as much more friction, and consequently wear out as much sooner than the hind-axle, as the fore-wheels are less than the hind ones. However, the carriers commonly put the heavier part of the load upon the fore-axle of the waggons; which not only makes the friction greatest where it ought to be least, but also precludes the fore-wheels deeper into the ground than the hind-wheels, although the fore-wheels, being less than the hind ones, are with so much the greater difficulty drawn out of a hole, or over an obstacle, even supposing the weights on their axles were equal; for the difficulty, with equal weights, will be as the depth of the hole, or height of the obstacle, is to the semi-diameter of the wheel. Moreover, since a small wheel will often sink to the bottom of a hole, in which a great wheel will go but a very little way, the small wheels ought to be loaded with less weight than the great ones; and then the heavier part of the load would be less jolted upward and downward, and the horses tired to much less, as their draught raised their load to less heights. When the waggon-road, indeed, is much up-hill, there may be danger in loading the hind-part much heavier than the fore-part; for then the weight would over-hang the hind axle, especially if the load be high, and endanger tipping up the fore-wheels from the ground. In this case, the safest way would be to load it equally heavy on both axles; and then as much more of the weight would be thrown upon the hind axle than upon the fore one, as the ground rises from a level below the carriage. But as this seldom happens, a small temporary weight might be laid upon the pole between the horses, which would overbalance the danger.

From Mr. Ferguson’s observations on the centre of gravity, it is evident, that if the axle-tree of a two-wheeled carriage passes through the centre of gravity of the load, the carriage will be in equilibrium in every position in which it can be placed with respect to the axle-tree; and
in going up and down hill, the whole load will be sustained by the wheels, and will have no tendency either to press the horse to the ground, or to raise him from it. But if the centre of gravity is far above the axle-tree, as it must necessarily be according to the present construction of wheel-carriages, a great part of the load will be thrown on the back of the horses from the wheels, when going down a steep road, and thus tend to accelerate the motion of the carriage, which the animal is striving to prevent; while in ascending steep roads a part of the load will be thrown behind the wheels, and tend to raise the horse from the ground, when there is the greatest necessity for some weight on his back, to enable him to fix his feet on the earth, and overcome the great resistence which is occasioned by the steepness of the road. On the contrary, if the centre of gravity is below the axe, the horse will be pressed to the ground in going up-hill, and lifted from it when going down. In all these cases, therefore, where the centre of gravity is either in the axle-tree, or directly above or below it, the horse will bear no part of the load in level ground. In some situations, the animal will be lifted from the ground when there is the greatest necessity for his being pressed to it, and he will sometimes bear a great proportion of the load when he should rather be relieved from it.

The only way of remedying these evils, says Dr. Brewster, is to assign such a portion to the centre of gravity, that the horse may bear some portion of the load when he must exert great force against it, that is, in level ground, and when he is ascending steep roads; for no animal can pull with its greatest effort, unless it is pressed to the ground. Now, this may in some measure be effected in the following manner: Let BCD (Plate XL., fig. 12.) be the wheel of a cart, A D one of the shafts, D that part of it where the cart is sustained on the back of the horse, and A the axe-tree; then if the centre of gravity of the load is placed at m, a point equidistant from the two wheels, but below the line DA, and before the axe-tree, the horse will bear a certain weight on level ground, a greater weight when he is going up-hill, and has more occasion for it, and a less weight when he is going down-hill, and does not require to be pressed to the ground. All this will be evident from the figure, when we recollect that if the shaft DA is horizontal, the centre of gravity will press more upon the point of suspension D the nearer it comes to it; or the pressure upon D, or the horse's back, will be proportional to the distance of the centre of gravity from A. If m therefore be the centre of gravity, b A will represent its pressure upon D, when the shaft DA is horizontal. When the cart is ascending a steep road, A H will be the position of the shaft, the centre of gravity will be raised to a, and a A will be the pressure upon D. But if the cart is going down hill, A C will be the position of the shaft, the centre of gravity will be depressed to n, and c A will represent the pressure upon the horse's back. The weight sustained by the horse, therefore, is properly regulated by placing the centre of gravity at m. We have hitherto, however, to determine the proper length of b a and b m, the distance of the centre of gravity from the axle, and from the horizontal line DA; but as these depend upon the nature and inclination of the roads, upon the length of the shaft DA, which varies with the size of the horse, on the magnitude of the load, and on other variable circumstances, it would be impossible to fix their value. If the load, along with the cart, weighs four hundred pounds, if the distance DA be eight feet, and if the horse should bear fifty pounds of the weight, then b A ought to be one foot, which being one-eighth of DA, will make the pressure upon D exactly fifty pounds. If the road slopes four inches in one foot, b m must be four inches, or the angle b A m should be equal to the inclination of the road, for then the point m will rise to a when ascending such a road, and will press with its greatest force on the back of the horse.

When carts are not constructed in this manner, we may, in some degree, obtain the same end by judiciously disposing the load. Let us suppose that the centre of gravity is at O when the cart is loaded with homogeneous materials, such as sand, lime, &c. then if the load is to consist of heterogeneous substances, or bodies of different weight, we should place the heaviest at the bottom, and nearest the front, which will not only lower the point O, but will bring it forward, and nearer the proper position m. Part of the load, too, might be suspended below the fore-part of the carriage in dry weather, and the centre of gravity would approach still nearer the point m. When the point m is thus depressed, the weight on the horse is not only judiciously regulated, but the cart will be prevented from overturning, and in rugged roads the weight sustained by each wheel will be in a great degree equalized.

In loading four-wheeled carriages, great care should be taken not to throw much of the load upon the fore-wheels, as they would otherwise be forced deep into the ground, and require great force to pull them forward. In some modern carriages, this is very little attended to. The coachman's seat is sometimes enlarged so as to hold two persons, and all the baggage is generally placed in the front, directly above the wheels. By this means the greatest part of the load is upon the small wheels, and the draught becomes doubly severe for the poor animals, who must thus unnecessarily suffer for the ignorance and folly of man.

There is another great disadvantage attending small fore-wheels; viz. that as their axle is below the level of the horse's breast, the horses not only have the loaded carriage to draw along, but also part of its weight to bear, which tires them sooner, and makes them grow much flatter in their hams, than they would be if they drew on a level with the forse-axe; and for this reason, coach-horses soon become unfit for riding. So that on all accounts it is plain, that the fore-wheels of all carriages ought to be so high as to have their axles even with the breasts of the horses; which would not only give them a fair draught, but likewise cause the machine to be drawn by a less degree of power.

Mr. Beighton disputes the propriety of fixing the line of traction on a level with the break of a horse, and says it is contrary to reason and experience. Horses, he says, have little or no power to draw, but what they have from their weight; otherwise they could take no hold of the ground, and then they must slip, and draw nothing. Common experience also teaches, that if a horse is to convey a certain weight, he ought, that he may draw the better, to have a proportional weight on his back or shoulders. Besides, when a horse draws hard, he bends forward, and brings his break near the ground; and then, if the wheels are high, he is pulling the carriage against the ground. A horse tackled in a waggon will draw two or three tons, because the point of line of traction is below his break, by reason of the wheels being low. And it is very common to see, when one horse is drawing a heavy load, his fore-feet will rise from the ground; and he will nearly stand on end; in which case it is usual to add a weight on his back, to keep his fore-part down, by a person mounting on him, which will enable him to draw that load, without which he before could not move. The great fires, or main butines of drawing, says this ingenious writer, is to overcome obstacles; for on level plains the drawing is but little, and then the horse's back need be pressed but with a small weight. Most or all of these obstacles may be considered
the line of traction. When the line of traction is horizontal, as $A D$, the lever of resistance is $C F$; but if this line is oblique to the horizon, as $A d$, the lever of resistance is diminished to $C f$, while the lever of the horse's weight remains the same. Hence it appears, that inclined traces are much more advantageous than horizontal ones, as they uniformly diminish the resistance to be overcome.

Whether, however, has investigated experimentally the most favorable angle of inclination, and found, that when the angle $D A F$, made by the traces $A d$, and a horizontal line, is fourteen or fifteen degrees, the horse pulled with the greatest facility and force. This value of the angle of draught will require the height of the spring-tree bar, to which the traces are attached in four-wheeled carriages, to be one-half of the height of that part of the horse's breast to that with which the fore end of the traces is connected.

This height is about four feet six inches, and therefore the height of the spring-tree bar should be only two feet three inches, whereas it is generally three feet.

8. The utility of broad wheels, in amending and preserving the roads, has been so long and generally acknowledged, as to have occasioned several acts of the legislature to enforce their use. See Turnpike.

Several excellent and well-considered experiments have not long ago been instituted by Bouard and Marguron, which have satisfactorily evinced the distinguishing advantage of broad wheels. See a Memoir presented to the Academy of Lyons, in the Journal de Physique, tom. xix. p. 424.

Nevertheless, the proprietors and drivers of carriages feem to be convinced by experience, that a narrow-wheeled carriage is much easier and speedily drawn by the fame number of horses as a broad-wheeled one of the same burthen. Although government allowed them to draw with more horses, and carry greater loads than usual, they were perforce compelled to comply with the requisition of legislation; and methods have been used to evade it. Their principal objection has been, that as a broad wheel must touch the ground in many more points than a narrow wheel, the friction must of course be so much the greater; not considering, that if the whole weight of the waggon, and load in it, bears upon many points, each sustains a proportional less degree of weight and friction than when it bears only upon a few points; so that what is wanting in one is made up in the other, and, therefore, will be just equal under equal degrees of weight, as appears by the following plain and easy experiment proposed by Mr. Ferguson.

Let one end of a piece of packthread be fastened to a brick, and the other end to a common scale for holding weights; then having laid the brick edgeways on a table, and letting the scale hang under the edge of the table, put as much weight into the scale as will just draw the brick along the table. Then taking the brick to its former place, lay it flat on the table, and leave it to be acted upon by the fame weight in the scale as before, which will draw it along with the same ease as when it lay upon its edge. In the former case, the brick may be considered as a narrow wheel on the ground; and in the latter as a broad wheel. And since the brick is drawn along with equal ease, whether its broad side or narrow edge touches the table, it shews that a broad wheel might be drawn along the ground with the same ease as a narrow one, supposing them equally heavy, even though they should drag, and not roll as they go along. Besides, as narrow wheels are always sinking into the ground, especially when the heaviest part of the load lies upon them, they must be considered as constantly going up hill, even on level ground; and their edges must sustain much friction by rubbing

WHEEL.
rubbing against the sides of the ruts made by them. But both these inconveniences are avoided by broad wheels; which, instead of cutting and ploughing up the roads, roll them smooth, and harden them; though, after all, it must be confessed, that they will not do in still, clayey crofs roads; because they would soon gather up as much clay as would be almost equal to the weight of an ordinary load; and also in passing along roads abounding with loose stones and other obfacles, which a narrow wheel may avoid passing over, and a broad one much furround the, the broad-wheel carriage will certainly be drawn less easily and less speedily than a narrow-wheel one, though not on account of any additional friction arising from the pressure of the weight on a greater quantity of surface. Broad wheels are likewise more liable to an inequality of pressure between the axle and box than narrow ones, and consequently to a greater wear and tear.


We shall here subjoin some additional remarks on wheels and axles for carriages. The essential qualities of wheels are strength and durability, and it is defirable that they should be as light as is convenient with strength: for quick travelling carriages lightness is very necessary.

Wheels to four-wheel carriages should be made as near of a height as the construction and appearance will admit; and if not required for heavy work, the lighter they are made the better. The fixtures from whence the draught is taken should be placed rather above the centre of the largest wheel, for advantage of draught.

The members of a wheel are of three descriptions; viz. the nave, or fock, which is the central piece; the spokes, or radii; and the fellies, or circumference. The nave or fock is made of elm, in which all the spokes are fixed, and in which the axletree-box, or wheel-box, is confined, to receive the axl-arms on which the wheel revolves. The spokes are straight timbers made of oak, firmly tenoned in the nave, in the direction of radials, to support the fellies, or wheel-rim. The fellies are made of ash, or beech, and form the rim of the wheel; the whole circumference is usually divided into short lengths, in the proportion of one length to every two spokes. When the fellies are fixed on the spokes, the iron band, or tire, which maintains the wear, is nailed on in lengths, and keeps the fellies together. The diameters of wheels regulate the number of spokes and fellies they are to con-tain: for the larger the circumference of the wheel is, the greater is the number of spokes required in proportion; for they should not in any wheel be more than fifteen inches distant on the fellies, or circumference.

The usual height or diameter of wheels for coaches and travelling carriages extends to five feet eight inches, and are divided into four proportions. Those which contain from eight to fourteen spokes, and only half that number of fellies, are called eights, tens, twelves, or fourteens, which are the number of spokes in such wheels, or of fellies in a pair of wheels. The height which regulates the number is, for an eight-spoke wheel, not to exceed three feet two inches; for a ten, four feet six inches; for a twelve, five feet four inches; for a fourteen, five feet eight inches.

These are the extreme heights for the different numbers of spokes to each wheel, which should be rather more than they are for the fore-wheel of a four-wheel carriage, which receives more pressure than the hind one; and the coach-maker's rule is, when the hind-wheels are of that height to require fourteen spokes, the fore one, if under the necessary height before stated, should have twelve; never allowing the fore-wheels to have but two spokes less than what is needful for the hind ones.

There are three descriptions of wheels; viz. the flanked, the hooped, and the patent rim: the differences of these are only in the rims.

The flanked wheel is made with the fellies in separate lengths or pieces, which are joined together at the ends by dowels; that is, a round pin which enters part into one piece and part into the other, being closely fitted into holes made in each. The iron with which it is plated is called the flake, and is put on in pieces of the same length as the pieces of the fellies, and fastened by nails; the joints of the iron are made to fall over the middle of the pieces of wood so as to unite them firmly together. The hooped wheel is sur-rounded by a hoop of iron in one entire piece. The patent wheel is made with a hoop of wood in one entire piece, by boring or softening the wood until it can be bent into a circle; this is surrounded by a hoop of iron in an entire piece, and fastened by nuts and rivets.

According to the usual method of constructing flanked wheels, their peripheries are composed of a number of pieces or fellies joined together; but these are weak, and subject to several inconveniences. As the joints are the weakest parts of the wheel, they are most liable to yield inward; for which reason the wheelwrights leave them higher than the other parts of the rim, in conformance of which the wheel is not exactly round within the circle of the rim. Besides, the fellies being segments of a circle, fawed or hewn out of straight wood, they are on this account rendered so brittle, from the course direction of the grain near the joints, that they are with difficulty kept together, even though almost twice the quantity of timber is employed that would otherwise be necessary. The strength of such a wheel depends on the thicknees of the iron tire or rim that surrounds it, and hence the carriage is loaded with an uneles weight, both of wood and iron. To obviate these inconveniences, Mr. Viny invented the process for bending timber into a circular form, practised for some time by Messrs. Jacob and Viny, and is now continued by others. In wheels made of timber thus bent, the rim confines either of a single piece of wood, or two fellies only, and is cased with a single hoop of iron. By this mode of construction, the grain of the wood is kept parallel throughout, so that the periphery of the wheel is everywhere equally strong; its thicknees is considerably leffened, inasmuch that though little more than half the usual quantity of timber is employed, the wheel is of itself strong enough to sustain the common burden laid on such wheels, without the assistance of iron tires, which are only applied to them as a safe-guard, to prevent the wood from the injuries to which it would otherwise be necessarily exposed from the roads; and hence a less quantity of iron is sufficient, and even that will be fairly worn out before it becomes useless. Besides, the wheel is rendered much lighter, and at the same time much stronger and more durable, than wheels constructed of detached pieces of wood and iron, in the usual manner. These patent wheels are very superior to the common fort, in their neat light appearance, and in the length of time they wear, as two fets of the former will wear as long as three of the latter: their preservation depends very much on the hoops that the wheels are rimmed with. Some persons still prefer the common fort of wheels, on account of their being more easily repaired than the hoop-wheel; but though the repairing of the latter is more difficult, they are much less subject to need it.

As the rims of wheels wear fonnet at their edges, they should
should be made thinner in the middle, and fastened to the fellies with nails of such a kind, that their heads may not rise above the surface of the rim. The fellies on which the rims are fixed should, in carriages, be three inches and a quarter deep, and in waggons four inches. The naves should be thickest at the place where the spokes are inferted, and the holes in which the spokes are placed should not be bored quite through, as the grease upon the axle-tree would infinate itself between the spoke and the nave, and prevent that close adhesion which is necessary to the strength of the wheel.

The track in which the wheels of every carriage are to run is generally the same, except when intended for particular roads, where waggon and other heavy carriages are principally used, and leave very deep ruts, in which light carriages must likewise run, or be liable to accident, and are also sure to be heavy in draught. All four-wheel carriages should have the hind and fore wheels regulated to roll in the same track. The ordinary width of the wheels is four feet eight or ten inches; that of waggon or carts generally measure five feet two inches; chaise-wheels, as being principally intended for the country, are adapted to this width.

It is immaterial to what width wheels are set if used for running upon stones; but on marly roads, if their exactness is not attended to, the draught is considerably increased. We have seen a carriage of which the iron axle-tree is made in two pieces, overlapping each other in the middle where they are joined, and secured by proper bands to the wood-work of the carriage, so as to admit of sliding in the direction of the axle-tree. These parts are cut with teeth like racks, and a pinion is applied between them; so that by turning this pinion round, the two parts of the axle-tree are made to slide one upon the other; and the wheels which are fitted upon the two extreme ends of the axle-tree can at pleasure be fixed at greater or less distance, as the roads require.

The different heights of hind and fore wheels make also a difference in the length of their axle-tree, agreeable to the proportion they bear to one another; the fore-wheel has the longest axle-tree by one or two inches between the shoulders.

The nave of the wheel is pierced through the centre, with a large hole to introduce the box, or iron tube, for the axle-arm, as this tends to weaken the wood. It has been frequently proposed to make metal naves, or centre-pieces for wheels, which should contain the box for the axis, and the mortises for the spokes of the wheel all cut of one piece of metal. Miers, Dodson and Skidmore had a patent for this in 1799. The objection to it, is, that, if the wood of the spokes shrinks, they become loose in the mortises, whereas a wooden nave shrinks at the same time with the spoke. This defect has been since remedied by making the metal wheel-flock in two parts; one with receffes, or sockets, to contain the spokes, and the other a flat plate to fasten against the former with screw-bolts, and press the spokes into their cavities.

Mr. Plucknett had a patent for a metal wheel-flock of this kind in 1805, which answered extremely well for carts, waggons, and artillery. The spokes were made to fill up all the space in the nave or flock, so that each spoke touched its neighbour. The metal flock was only a flat circular plate, or flanch, projecting from the box which received the axle, and another flat plate fitted upon it, and bound against the former by screw-bolts, one passing through each arm; these rendered the wheel very strong.

Mr. Wilks took a patent in 1813 for a metal flock, in which there are complete cells for each spoke, and the cells are dove-tailed; that is, they are made larger at the central part than at the outside, to prevent them from drawing out, and they are firmly pressed into the dove-tails by the screw-bolts which confine the moveable plate.

Wheels for railway-waggons are made of cast-iron, and usually all in one piece; but this is objectionable, because the unequal contraction of the arms and rim of the wheel in cooling, after the wheel is cast, puts the different parts on a strain, and they frequently break without any adequate force. It is better to cast the rim in one piece and the arms in another, and put them together with screw-bolts, or rivets.

Mr. Hawks had a patent for this in 1807. In this way, the rims may be replaced when worn out.

The Axle-trees for Wheels of Carriages.—The strong iron bar which extends across beneath the wood-work of the carriage, is called the axle-tree; the round parts at each end, on which the wheels run, are called the axle-arms; and the part or item between them, which is fixed beneath the wood-work of the carriage, is also called the axle-tree. In the form of the latter parts there are but two forts, the one made flat, and called a bedded axle-tree, it being sunk all its length in the under side of the timbers of the carriage; the other is made of an octagon form, and flat only at the ends where they are bedded.

The axle-arms on which the wheels turn should be made perfectly round, and somewhat stronger at the shoulder than at the extreme end, which is fixed to receive a nut, through which and the axle-tree the linch-pin passes, to keep them all tight. The nuts are made with a collar at the face; and a temporary collar, or washer, is driven on the back of the arms, which form two shoulders for the wheel to wear against, and helps to prevent the grease from running out, and to prevent dirt from getting in.

As the axle-trees are the principal or only support of the carriage, every attention and care should be fixed in the selection of good iron; and to see that they be well wrought, and of sufficient strength, rather going to the extreme of strength, than risking the life of the passenger by the over-fetting of the carriage, which mostly happens when an axle-tree breaks.

By the bend of the axle-trees, the wheels are regulated to any width at bottom, to suit the track of the roads in which they are to run, and are confined in the carriage by means of clips, hoops, and bolts. The shape of the axle-tree between the shoulders varies according to the situation they are placed in, or the form of the timber of the carriage with which they are united; those are the most firm that are flat, or bedded in the timber. Axle-tree boxes for wheels are of various kinds; those which are frequently called long-pipe, or wheel-boxes, are long tubes fitted accurately to the arms of the axle-trees, and securely fixed in the wheel-rocks, or naves; they are usually made of wrought sheet-iron of a substance proportioned to the weight of the carriage; their use is to contain a supply of grease, and to prevent the effects of friction, whereby the wheels are much afflicted in their motion. These are now used instead of the old cast-iron boxes, which for quick travelling-carriages are totally out of use, being found injurious to the axle-trees, by cutting them at those parts they wear against, so as to occasion a frequent lining of the arms; but with the wrought metal boxes this is seldom necessary.

There are many forts of axle-trees and boxes invented various ways, with a view of attaining the following advantages; viz. To contain a longer supply of grease or oil, to be more durable, to secure the wheels, and to lessen the draught. Those are all certainly great advantages, and though the expense is great, the utility of either of them must be more than adequate to it, and merits more general notice.

Some
Some of these inventors even pretend that all these advantages are combined in one axle-tree; but the generality extend to the advantage only of retaining a supply of oil, and remaining perfect to a considerable length of time. The common form of axle-tree and box, which is most generally used, is simple and cheap in comparison with the others.

Common Axle-tree.—The arms of the axle-tree are made round, but rather of a conical form, strong at the back or shoulders, tapering to the line end, which is screwed for a nut, and also has a small hole for a linch-pin, which prevents the nut from coming off: at the body-end is a washer or collar for the back of the wheel-flock to wear against. The box is made of sheet-iron, proportioned in substance to the weight or size of the axle-tree, having the edges of the plate, of which it is formed, welded in a ridge which projects on the outside; this secures the box in the nave of the wheel, and prevents it turning round therein.

The nut which screws on the end of the axle-arm has a broad face to lie flat against the wheel, and is tapped or screwed to receive the screw-end of the axle-tree. Each of these nuts must turn on the screw the same way the wheel goes, and must have a notch for the linch-pin to pass through, for the purpose of securing the nut from turning off.

The box is what, of the axle-tree, wears most, and is frequently obliged to be refitted to the arms; otherwise they give to the wheel while in use an unsteady motion, and soon exhaust their flock of grease.

Those that are well fitted will contain their supply for about one week with regular use, or a journey of one hundred miles. They wear at the rate of one set of boxes to every two fets of wheels, and require in that time to be twice or thrice taken out of the wheels and refitted to the axle-tree arms.

Axle-trees with Friction-Wheels.—These were invented by Mr. Garnet, at least the best kind, which are made in a very ingenious manner. The wheel-box is made much larger than the axle-tree, in such manner that the space all round between them may receive a number of rollers which fill it up. (See a description in the article Mill-Work.) Mr. Garnet had a patent in 1784, and for some years manufactured great numbers; but being very expensive, they fell into disuse, although very complete. This invention has been lately revived by Mr. Panter.

The Patent Anti-Attrition Axle-tree and Box.—The proposed advantages of this axle-tree are, ease of draft by diminution of friction; the retention of oil to supply a month's use; the ease with which it is replenished without taking off the wheels; the great security for the wheels, which it prevents from coming off, and the carriage from overturning, if even the arm of the axle-tree should break; and their durability, and even improvement by wear. Tho' axle-trees, if made with the securing-collar, for the wheels need no nut or linch-pin, as is generally used, but the wheel may be taken off and put on as easily as tho' on the common principle.

These axle-arms are reduced at the bottom from a perfect round, and grooved, to receive two small rollers, on which the weight of the carriage is borne, and which greatly facilitates the motion, in the same manner as blocks of stone or timber, which require to be removed by the affittance of rollers. These rollers form the outer circumference of the axle-trees at bottom, which are reduced to give a bearing only on them. A circular box or cistern is provided to contain a supply of oil; it is closely fitted to the back of the inner end of the wheel-flock, and fixed by three bolts.

The oil is here contained within three circular recesses, and oozes through small channels on the arm of the axle-tree, which it feeds for a considerable time. This oil-box is made of cast-metal, and has a cap projecting behind the axle-tree, which prevents the dirt from getting into the box. This axle-tree is also provided with what is called the wheel-security, or strap-washer. It is an iron collar, fitted on the external part of the wheel-stock, and confined between the referror and flock, lying as it were in a groove, so that the collar cannot come off. This collar has two lugs or straps extending backwards some distance along that part of the axle-tree which is bedded in the wood-work, where it is fixed by a nut-screw. By means of this strap-washer, the wheel is secured to the bedded part of the axle-tree; and should the axle-arm within the wheel break, the wheel will continue to act.

The cap of this axle-tree is also fixed on the outside part of the wheel-stocks; by the same three bolts which fasten the oil-box, and by means of a screw-plug in the cap, the axle-tree and referror are replenished with oil.

The box is of the same form as the common box, only made of a very hard durable metal, of a considerable thickness, and is made in proportion to the weight of the carriage.

Collinge's Patent Cylinder Axle-tree and Box.—These axle-trees have been a considerable time in use, and their advantages have been proved in the length of time they wear, in the silent and steady motion they preserve to the wheels, in the advantage of retaining the oil to prosecute a journey of two thousand miles without being once replenished; and lastly, they are very durable, and but little subject to be out of order.

The axle-tree arm is made as perfectly cylindrical as possible, and of a peculiar hard substance; the middle of the cylinder is reduced, to contain the oil necessary to feed the axle-trees; so that the two bearings are at the two ends of the axle, which has an internal shoulder, against which the inner end of the wheel-box takes its bearings. Behind this shoulder is a deep groove for a washer to preserve the oil, and prevent noise in its use; also a rim, or hollow box, on the collar of the axle-tree, which overlaps part of the inner end of the wheel-flock to keep out dirt, and anwser the use of a cuttow. The extreme end of the arm is double-screwed, to receive two nuts for securely the wheel: the one screw turns the way of the wheel; the other the reverse, and is meant as an additional security.

The box is made of a-very hard metal, nicely polished, and fitted to the arms, having a circular recess all round at the end nearest the carriage, for containing there a supply of oil. The box is longer than the part which bears on the axle; and the projecting part beyond the bearing at each end is bored out larger than the arm. The back projection fits close to the rim of the collar, which it covers: the fore one projects outwards beyond the surface of the wheel-flock, and is screwed on the inside to receive the screw of the cap.

There are many other patents for axle-trees to wheels; but as few of them have come into use, we shall only notice Messrs. Flight and Brook's patent axles. The axle is fixed fast to the nave of the wheel, by passing through it. This axle turns round within the wheel-box; whereas in others the wheel-box turns round upon the axle.

The axle is cylindrical, and is received into a cylindrical box or tube in the end of the iron axle-tree, which is firmly bolted to the under side of the timber of the carriage. To hold the axle in its place, and prevent it from drawing out of the box, the end of the axle is reduced to a knob or button, which adheres to the end of the axle by a small neck.

Vol. XXXVIII.
neck. This button is fitted and received into a socket, in which it can freely turn round, but cannot draw out endways. It is made in a piece of metal, which is cylindrical on the outside, and of the same fize as the axle. It is made in two halves, which separate longitudinally to introduce or take out the button at the end of the axle; but when the two halves are put together, the socket-piece forms as it were a continuation of the axle. When the axle is put into the box with this socket-piece at the end of it, the two halves of the socket will be confined together, so that they cannot separate; and to prevent them from drawing out of the box, a screw-bolt is put through the box, and passes through both halves of the socket: this holds the socket and the axle in their places.

Mr. Ackermann has recently obtained a patent (1818) for a valuable improvement in the application of the forewheels to four-wheeled carriages. In our article Coach-Making, vol. viii. we have described those methods which were then known of applying the fore-wheels, fo as to make a four-wheel carriage turn with safety, and in a small space. See also Perch.

Mr. Ackermann's improvement consists in this in the most perfect manner. Each of the fore axle-trees is connected with the carriage by means of a vertical axle, formed in the fame piece with the horizontal axle, and upon which the wheel turns, the two halves being situated at right angles to each other. These vertical axles are fitted into sockets, formed at the two extremities of a crofs beam of the frame of the carriage, which is called the fore-spring transom. Upon these axles, as centres of motion, the axle-arms and wheels can be turned about horizontally, in order to place them obliquely to the direction of the hinder-wheels when the carriage is required to turn; but each axle turns upon a separate centre of motion, and these centres are very near to their respective wheels, being at the extremities of the crofs-beam or transom; hence the fore-wheels do not change their place upon the ground when they are placed obliquely.

In a common carriage, the axles of the two fore-wheels are both fixed to one piece of timber, called the axle-bed, which is placed beneath the fore-tranform, and united to it by a vertical pin called the perch-bolt, passing through the middle of the axle-bed. On this pin, as a centre, the axle-bed is turned round. When the wheels are to be placed obliquely, it is evident, that, in so turning upon a single centre, one wheel must advance forwards, and the other must retreat backwards, fo as to diminish the bearing of the carriage-wheels on the ground in a lateral direction, and at the same time the horses are pulling in that direction which tends to overturn the carriage. Another inconvenience is, that one of the wheels will touch the perch of the carriage, if placed very oblique.

In the new improvement, two separate centres of motion being used, and these being removed from each other as far as possible, many defirable properties are attained.

To give the oblique direction to the wheels, each vertical axle has a lever proceeding backwards from it; and these two levers are united together by a connecting-bar, which oblige both axles to move at the same time with a sympathetic action. The pole of the carriage is united to the piece, called the futchel, in the usual manner; and the futchel is united to the spring-tranform by a perch-bolt, in the usual position; also the hinder end of the futchel is joined to the middle of the connecting-bar, between the two levers of the vertical axles. The connecting-bar likewise answers the purpose of a fway-bar.

When the horses move to one side, the pole and futchel turn upon the perch-bolt, as a lever upon a centre of motion; and the extreme end of the futchel acts upon both vertical axles at once by means of the connecting-bar, fo as to place both of the fore-wheels in an oblique direction. This is the invention of M. Lankenperger of Munich.

Wheel, Arifofla's. See Rota Arifotelica.

Wheel, Blowing, a machine contrived by Dr. Defagu-liers for drawing out the foul air of any place, or for forcing in fresh, or doing both successively, without opening doors or windows. See Phil. Trans. N° 437.

The intention of this machine is the fame as that of Dr. Hales's ventilator, but not fo effectual, nor fo convenient. See Defagul. Course of Exper. Philof. vol. ii. p. 553. 568.

This wheel is also called a centrifugal wheel, because it drives the air with a centrifugal force.

Wheels, Baffes or Boxes of; the infide metal linings of the naves. See Wheel.

Wheel, Cutting Roller, in Agriculture, a tool of the cutting and reducing fort, ufed for the purpose of working over crops in some cafes. In Oxfordshire a cutting roller of this fort has been invented, which is composed of twelve wheels, two inches and a half in thickness; and between each of them is a space of two inches and a half. They are three feet in diameter. It is a load in working fo as to be sufficient exertion for a strong team to draw it; it is paved over wheat after it has been fown, or after it is come up; and if dry, crofs and crofs. It has also been ufed in the spring upon wheat; it leaves the surface rough in a fort of diamond forms, which is found very beneficial in some of the wheat-lands of that diftriet. It is also capable of being ufed in breaking down the surface of stiff tillage-land in many other cafes and circumstances.

Wheel, Draining, a wheel constructed for the purpose of cutting or making drains. Wheels differently formed are ufed for this fort of work. In Essex they employ workmen who make use of a cast-iron wheel which weighs about four hundred weight, and which is four feet in diameter; the cutting edge or extreme circumference of the wheel being half an inch in thickness, which increses in this way as it approaches towards the nave or centre; and will, at fifteen inches deep, scour out or cut a drain half an inch wide at the bottom, and four inches wide at the top. The wheel is fo placed in a frame, that it may be loaded at pleasure, and be made to pass to a greater or lefs depth, as the nature of the land may be.

The writer of the Middlefex Report on Agriculture advises the ufe of a common fix-inch cart-wheel, on theelly of which, all round, a fort of ridge-formed addition of wood is to be fixed, and a rim of iron of a triangular shape fastened to the wood. A wheel of this kind put on the axle of a cart, in the usual way, will, of course, reit on the edge of the rim of iron; and which, on driving the horse forward, will make a small indent or depression in the ground merely by the revolution of it; but in order to make it press down to the depth of fix or eight inches, that side of the cart shoild be loaded with stones, iron ballaft, or any other heavy material that may happen to be at hand, until the whole of the parts, if neceffary, sink into the soil. It would however be as well, or better, it is faid, if the rim parts added to the wheel were in one piece of cail-iron; as the increased weight of it would enable it to cut or sink without the aid of ballaft, or with lefs than usual. The cart shoild then be drawn along in such a manner, that the cutting or deprefling wheel may revolve where the drains are intended to be made. In land that is ridges and furrows, it will sometimes be neceffary to draw the wheel along every furrow.
furrow. When the ground is without ridge and furrow, the wheel should be drawn over it in parallel lines, five or ten yards distant from each other. The wheel on the other end of the axle is a common fix-inch wheel, supporting only the empty side of the cart, consequently will not cut or depress the ground.

The advantage of this contrivance is, that it makes an indent or depression in the surface of soft wet clayey grass-lands, sufficient to carry off the water during the famine winter, by prefling down the furrow and herbage without destroying it. In the following spring, these drains will be nearly grown up, and clothed with grass; consequently, there will be nothing taken from the pasturage or the leythe. It is necessary to observe, that the wheel must be drawn over the ground every year on the approach of winter. With it, and two old horses, a stout boy or man may, it is said, drain from ten to twenty acres in eight hours.

It may be found very useful in the grazes and hay land districts about the metropolis and other places. See Surface Draining.

Wheel, Measuring. See Perambulator.
Wheel, Offreyus's. See OFFREEUS.
Wheel, Perian. See PERSIAN.
Wheel, Ploughs, in Agriculture, all such ploughs as are constructed with wheels. See Plough.

Wheel, Potter's, is a round board attached to a lattice, and capable of being moved by it, either rapidly or more slowly, as occasion may require. This round board moves in a horizontal position; and when in use, the clay which is to be fashioned is fixed on the centre of it; and it is put in motion either by a person who constantly attends it when at work, or by means of a treadle which is moved by the foot of the workman himself.

As the clay revolves upon this machine, the workman either models it by his fingers, or forms it, by means of an instrument which he holds in his hand, into any kind of circular shape that he may desire; and when the object is to make a number of vessels exactly similar to each other, the size is generally determined by a gauge fixed without the circumference of the revolving wheel, but projecting over it in such a manner that, whenever the yielding clay is spread out until it touch this gauge, the artist knows that the article which he is making has attained the exact figure which he intends.

The potter's wheel has lately been much improved by adapting a flap to it, which passes over a large taper cylinder of wood, and by means of which the artist is enabled to increase or diminish the rapidity of the motion at pleasure. This contrivance is known to mechanics by the name of the cone pulley. Parke's Elays, vol. iii. See Pottery.

Wheels, Tires of, the iron hoops or bars which are put round the outides of the felly-parts of them.

Wheel, Water. See Water.

Wheel is also a name of a kind of punishment, which great criminals are put to in divers countries.

In France, their affilins, paricides, and robbers on the highway, were condemned to the wheel; i.e. had their bones first broken with an iron bar on a scaffold, and then to be exposed and left to expire on the circumference of a wheel. In Germany, they broke their bones first on the wheel itself.

This cruel punishment was unknown to the ancients; as is observed by Cujas. It is not certain who was the inventor. Its first introduction was in Germany. It was, indeed, but rarely practised any where else, till the time of Francis I. of France; who, by an edict of the year 1534, appointed it to be inflicted on robbers on the highway. Richelet dates the edict in the year 1538, and quotes Brodeus, Miscell. lib. ii. cap. 10.

Wheel, in the Military Art, is the word of command, when a battalion or squadron is to alter its front, either one way, or the other.

To wheel to the right, the man in the right angle is to turn very slowly, and every one to wheel from the left to the right, regarding him as their centre; and vice verfa, when they are to wheel to the left.

When a division of men are on the march, if the word be, wheel to the right, or to the left; then the right or left-hand man keeps his ground, turning only on his heel, and the reft of the rank move about quick, till they make an even line with the faid right or left-hand man.

Squadrons of horse wheel after much the fame manner.

In wheeling, the circle is conceived to be divided into four parts; whence wheeling to the right or left respects only a quarter of a circle; and wheeling to the right or left about, refers to half of the circle. In performing this motion, each man moves more quickly or slowly, according to his distance from the right to the left. See Battalion.

Wheel, or Catherine-Wheel, in Architecture, frequently occurs in the upper part of the north and south transepts of our ancient cathedrals, being divided by mulions, like the spokes of a wheel: it resembles the engine of torture said to have been prepared by the tyrant Maximin to tear the flesh of St. Catherine of Alexandria. The French, who have generally placed a large wheel of this fort by way of a western window to their cathedrals, call it Rèfe du Portail.

Wheel-Animals, Brachionus, in Zoology, a genus of animacules, which have an apparatus of arms for taking their prey. (See Brachionus.) This apparatus has been supposed, by microscopical writers, to be a kind of wheels. This is one of the smaller animacules; and is described by Dr. Hill to be, when at rest, of a plain smooth body, conic figure, obtuse at the posterior extremity, and open at the anterior, of a dull olivine olive, and semi-transparent. When in motion it protrudes from the open extremity a part of its naked body, to the whole of which this outer conic body seems to be but a cafe or sheath; from the end of this exerted part of the body, it thrauls out two proubrances, which give it the appearance of a double head; and in each of these is discovered an apparatus in continual motion, appearing to be a rotatory one, though really a vibratory one very quickly repeated. Each of these protruded bodies has five arms injected into it, which it continually shuts and opens over one another. Each of the arms is furnished with a double series of fibres at its edge, which, being expanded, cause it to spread to considerable breadth. There are several species of this genus.

The wheel animal, described by Mr. Baker, has two seeming wheels, with a great many teeth or notches coming from its head, and turning round as it were on an axis. On the least touch, this animacule draws its wheel into its body into the sheath; but when every thing is quiet, throws them out and works them again.

In order to find these animacules, choose such roots of duck-weed as are long, and proceed from thence old plants, for the young roots seldom afford any; they should not be covered with that rough matter which is frequently found about them, nor any way tending to decay, as they will often be.

In the water found remaining in the leaden pipes, or gutters on the tops of houses, there are also found great numbers
numbers of these wheel-animals. These are of a different species from the former; and when the water dries away, they contract their bodies into a globular or oval figure, and are then of a reddish colour, and remain mixed with the dirt, growing together in a lump as hard as clay. This, whenever it is put in water, in half an hour's time discovers the animals' living again, and as briskly as ever; and they have been found to be living in this manner, after the matter had been kept dry twenty months.

It should seem from this, that as the water dries up, their pores become shut in the manner of those of such animals as remain torpid for the winter; and that when they find water come on again from rain, they then unfold themselves, and live and feed as long as it lasts. Baker's Microscope.

Wheel-Barometer. See Barometer.

Wheel-Boats denote a sort of boats with wheels, to be used alternately on the water and upon inclined planes or roadways.

Wheel-Fire, among Chemists, a fire used for calcining metallic substances; properly called ignis rotus.

It is a fire which only encompasses the crucible, coppel, or melting-pot, around the sides, without touching it in any part.

Wheel-Shaped, in Botany, a term exclusively appropriated to the corolla. See Rotata.

WHEELER, among Brickmakers. See Brick.

WHEELER, in Geography, a river of Wales, which runs into the Clyde, 3 miles N. of Denbigh.

WHEELING, a post-town of Virginia, at the union of Wheeling Creek with the Ohio; 54 miles S.W. of Pittsburgh.—Also, a township of Ohio, in the county of Belmont, with 676 inhabitants.

Wheeling Creek, a river of Virginia, which runs into the Ohio, N. lat. 39° 56'. W. long. 80° 45'.

Wheeling Planks are float planks which the navigators or workmen upon a canal make use of to wheel upon.

WHEELock, in Geography, a township of Vermont, in the county of Caledonia, containing 963 inhabitants; 60 miles N. of Windsor.—Also, a river of Cheshire, which runs into the Dane.

Wheelwright Gut, a creek on the north-west coast of the island of St. Christopher, with a bar before its entrance.

WheeZing and Blowing, in Animals, a sort of affection in the breathing, especially in horses, in which they draw their breath with difficulty and noise.

The generality of people make this and purfiness in horses, the same disease; but the more judicious always distinguishes it, as wholly different from that. Purfiness proceeds always from a stuffing or oppression of the lungs; but this wheezing is only owing to the narrowness of the passage between the bones and gristles of the nose.

The horses that are most of all afflicted with this distemper do not want wind; for notwithstanding that they wheeze excessively when they are exercised, yet all the time their flanks are not moved, but kept in the same condition that they were when the creature stood still. The dealers call this sort of horses blowers, and though there is no real harm in the thing, it is a disagreeable quality, and few people will choose them that have much service for them.

There are some horses which have a natural defect in their breathing, which makes it at all times attended with some difficulty, but not with the wheezing before mentioned; these are called thick-winded horses.

People who are careful in the buying of horses, will purchase neither of these kinds; but there is this caution to be observed in regard to this defect, that it often seems to be in horses where it really is not. When a horse has been kept a long time in the stable without exercise, he will at the first rising be out of breath, and fetch it in a difficult and painful manner, though he be neither a blower nor thick-winded; but all this will go off with a little exercise.

There are some temporary blowers and blazers among horses; these at times rattle, and make a great noise through their noses in taking breath; but the complaint goes off and returns. This is only occasioned by a great quantity of phlegm, for their flanks do not redouble with it at the word of times, nor have they any cough with it; so that there is no danger of their being purgy.

It is probable, that in these cases there is, for the most part, some fort of phlegm or concretion in the chests of the animals, as they are much relieved in moist influences by the use of warm mashes, and by having their fodder made moist.

How far remedies that remove phlegm might be useful has not yet been fully tried, either in these or other forts of animals.

WHELDY-ahad Lake, in Geography, a lake of North America. N. lat. 61° 40'. W. long. 103° 30'.


Gen. Ch. Cal. Perianth inferior, of one leaf, in five deep, roundish, erect, permanent segments, shorter than the corolla. Cor. of one petal, bell-shaped, spreading, in five deep, ovate, acute segments. Nectary somewhat pitcher-shaped, in the bottom of the flower. Stam. Filaments five, awl-shaped, rather longer than the corolla; anthers roundish. There are five other filaments, alternate with the former, and similar to them, but shorter, and defitute of anthers. Pyl. Germen superior, conical, vilious; style thread-shaped, twice the length of the corolla; stigma simple. Peric. Drupa roundish. Seed. Nut large, ovate, of one, two, or three cells.

Some flowers, on the same plant, want the pistil, others the stamens.

This is Schreber's generic description, from which we learn, without difficulty, the natural order of the plant. But it is one of those genera, like his Villaria, (see that article,) which cannot be determined without an examination of the author's herbarium. Such also are his Meyera, already described; his Wolfia, and Xystris, which will occur hereafter. We trust some botanist, who may have the opportunity of clearing up these, the only important obscurities in Schreber's classical work, will favour the world with an explanation of them. Spartina is in the same predicament, except that professor Schrader appears to be acquainted with it. See that article.

WHELKS, Buccina, in Natural History. See Shells, and Trumpet-Shell.

Whelps. See Hound.

Whelps, in a Ship. See Capstan.

Whennuia, in Geography, a small island among those called the Society islands, near Otahe.

WHERLICOTES, a sort of open chariots, of the ancient Britons' invention, used by persons of quality before the invention of coaches.

Whern,
WHERN, in Natural History, a name given by some of our miners to a kind of stone found in Hurra, but of the hardnes and fineness of flint. It is called allo chert and nitrina.

WHERRY. See Vessel, Boat, &c.

Wherry, in Rural Economy, a provincial term applied to a liquor made from the pulp of crabs after the verjuice is exprifed. It has not unfrequently the name of crabwherry. See VERJUICE.

WHERWELL, in Geography, a village of England, in the county of Hants. Here was formerly a convent of nuns, founded by Eftilda, widow of king Edgar, to expiate the murder of her first husband, Ethelwulf, and her fon-in-law, prince Edward; 4 miles S. of Andover.

WHET-SLATE, or Whetstone Slate, and Hone, French novacuité, phible calcite, in Mineralogy, a variety of flate used for sharpening iron and fleel instruments. (See Slate.) The light green coloured variety from the fenerate is confidered as the most valuable. It is brought in maffes to Marfells, and is there cut into pieces of various fizes, and afterwards ground with sand or sand-stone, and then polifhed with pumice and triploli. These whet-planes or hones should be kept in damp places, for when much expofed to the fun, they become too hard and dry for many purpofes. The powder of whet-flate is used for cutting and polishing metals, and is by artifts confidered as a variety of emery. It is neceffary to the perfection of hones, that they should contain no intermixt substances, fuch as quartz, &c. (Jamefon's in Mineralogy, second edition, vol. 1.) Whet-flate, approaching in appearance to foreign hones, occurs in the upper part of Long Sleddale, in Welfmoreland; and at Howe, in Dublin bay.

WHET-STONE, in Rural Economy, the soft flone fecondly made use of in sharpening edge-tools of different kinds.

WHEWER, in Ornithology, a name used in some parts of England for the common figeon. See DUCK.

WHEY, the ferum, or watery part of milk.

In many diforders of the human body, where the fomach will not bear milk, or when it is not proper, for other reafons, whey may be given with great fuccefs.

We have a defcription of Fred. Hoffmann on this fubjed, De Saluberrima feri Laftis Virtute. Oper. tom. vi. p. 9. This author recommends a particular kind of ferum or whey, made by evaporating milk to a drynefs, and mixing the refiduum with water. See MILK.

There are various methods of making whey, vulgarly known. That with oranges is very agreeable, and much recommended by Dr. Cheyne, in his Nat. Method of curing Difeafes.

WHEY, in Rural Economy, a term applied to the ferior part of milk, from which the curd has been separated. There are two forts or colours of whey, the green and white; the latter is by much the richer, and that which chiefly affords the bitter of this kind. See DAIRYING.

WHEY, Alum. Serum Aluminium, a whey made with alum; in the proportion of two drachims of alum to one pint of cow's milk boiled. This whey is beneficial in an immoderate flow of the menses, and in a diabetes, or exceflive discharge of urine. The dofe is two, three, or four ounces, as the fomach will bear it, three times a day.

WHEY-Butter, which is made from the cream of whey. It is commonly made in abundance in the dairy dis- tricts after cheese-making begins. See DAIRYING.

WHEY-Cream, which is collected from off the whey and made into butter of this fort. A dairy cow ufually affords eight or ten ounces of it weekly in some dairies. See DAIRYING.

WHEY, Muffard, is made by boiling of bruifed muffard feed, an ounce and a half, in milk and water, of each a pint, till the curd is perfectly separated, and draining the whey through a cloth. This, says Dr. Buchan, is the most elegant, and by no means the lead efficacious method of exhibiting muftard: it warms and invigorates the habit, and promotes the different fcercrations. Hence, in the low flate of nervous fcercrations, it will often supply the place of wine; it is alfo of ufe in the chronic rheumatism, palfy, dropfy, &c. The dofe is a tea-cupful four or five times a day, which may be sweetened with a little fugar.

WHEY, Scalding, of the heating of it and pouring it over the curd in making cheefe.

WHEY, Scorbutic, is made by boiling half a pint of the scorbutic juices, in a quart of cow's milk. The scorbutic plants are, bitter oranges, brook-line, garden feeru-grafs, and water-crellies.

WHEY Springy Cheefe, the ceyy spongy cheefe of this fort, camed by being improperly made.

WHEY Tub, the vefel in which the whey stands for yielding the cream, &c.

WHICHCOTE, BENJAMIN, in Biography, an eminent divine of the English church, was born in March 1603, 16, of an ancient family at Whichcote-hall, in Shropshire; and having finifhed his education at Emanuel college, Cambridge, in 1626, he pasfed through the common degrees, and became fellow of his college in 1633, and a distinguihed tutor. In 1636 he took orders, and established a lecture at Trinity church, in Cambridge, and continued in it for nearly twenty years. It was his great objeft to subftitute a spirit of fober and rational piety in the university, instead of the enthufiasm and fanaticifm which then prevailed; nor were his efforts for this purpofe unavailing. Being married, and having settled on a living in Somerfifh, his connection with the university was for fome time interrupted; but in 1644 he returned to it, as the successor of Dr. Samuel Collins, the ejected provoft of King's college, allowing to him part of the emoluments that belonged to this office. In 1649 he took the degree of D.D., and was prefented to the rectory of Milton, in Cambridgefhire. He is repreffed by bishop Burnet as a friend to liberty of confeffion, and in order to promote rational and ftimulating ideas of religion, he advised the fudents to perufe the ancient philosophers, efpecially Plato, Cicero, and Plutinus. At the Reformation he was deprived of his provoftship, and re- moving to London, he was chosen minifter of St. Anne's, Blackfriars, in 1662. Afterwards, when his church was burnt down, he retired to Milton, but he was recalled to London to the vicarage of St. Lawrence, Jewry, by prefentation from the crown; and he ferved this church with great reputation till his death in 1683.

After his death, a volume of his "Select Sermons," 8vo. 1698, was published, with a preface by lord Shaftesbury, author of the "Charactefitics," by whom they were valued, becaufe the author recognized that fene of the beauty of virtue which is the foundation of his moral fystem. Two more volumes were afterwards published by Dr. Jeffery, archdeacon of Norwich, who, in 1703, prefented to the public "Moral and Religious Aphorifms collected from Dr. Whichcote's MS. Papers." A fourth volume was published by Dr. S. Clarke in 1707, and reprinted in 1753 by Dr. Salter, with large additions, and eight letters between the author and fome of his friends on impofant fubjefts.
These several publications assigned to Dr. Whichcote a high rank among the rational divines of this country, and particularly at the period in which he lived. Biog. Brit.

WHICKS, in Agriculture, a term sometimes applied to young plants of the white-thorn kind, as well as to couch-grasses. See Quick's and Couch.

WHIDAH, in Geography, a kingdom of Africa, on the Slave Coast; extending about ten miles along the coast, and about seven miles into the land. Europeans who have been in Whidah speak of the country with rapture, and extol it as one of the most beautiful in the world. The trees are straight, tall, and disposed in the most regular order, which preëst to the eye fine long groves and avenues, clear of all brusk-wood and weeds. The verdure of the meadows, the richcnes of the fields, clothed with three different kinds of corn, beans, roots, and fruits, and the multitude of houes, form a most delightful prospect. A perpetual spring and autumn succeed each other; for no sooner has the husbandman cut his corn, than he again ploughs and sows the ground; yet it is not worn out; the next crop puts forth with the same vigour as the former, as if nature here were inexhaustible. Certain it is, that the kingdom of Whidah is so populous, that one single village contains as many inhabitants as several entire kingdoms on the coast of Guinea; and yet they stand so close, that one is amazed how the most fertile land on earth can supply the number of people contained in so small a compass. One may compare the whole kingdom to a great city, divided by gardens, lawns, and groves, instead of streets, the villages in Whidah not being a mufket-shot distant from each other. Some are the king's, some the vicerey's villages, and others are built and peopled by particular private families. The former are the largest and best built; but the latter the best cultivated, if there be any difference in a country so uniformly rich and beautiful. Notwithstanding the small extent of this kingdom, it is divided into twenty-six provinces, which take their names from the capital towns. Thosc small states are distributed among the chief lords of the kingdom, and become hereditary in their families. The king of Whidah, who is only their chief, presides particularly in the province of Sabi, or Xabier, which is the principal province of the kingdom, as the city of the same name is the capital of the whole. Buis, which the French by corruption call bauges, pass frequently for money at their fairs in the country; this is a small white shell, of the fize and shape of an olive. In the kingdom of Whidah and Ardra, these buis serve equally for drefs and money, for ornament and use. They pierce each shell with an iron made for that purpose; forty of them they fling upon a cord, which they call feuze, and the Portuguese toquen: five of these strings compose what the Portuguese call a gallinba, and the Negroes a fore. By the exchange of gold-duft is rated, and the price of slaves determined. The Europeans, the nobility of Whidah, and all the rich negroes, are carried, when they go abroad, in hammocks, or palanquins, on the shoulders of slaves. The natives of Whidah are in general tall, well made, straight, and robust. Their complexion is black, but not so gloomy as that of the people on the Gold Coast, and still less than those of Senegal and the river Gambia. They exccl all other negroes in industry and vigilance. Idlenes is the favourite vice of the Africans in general; here, on the contrary, both sexes are so laborious and diligent, that they never dream till they have finished their undertaking; carrying the same spirit of perseverance into every action of their life. Besides agriculture, from which none but the king and a few persons of the first distinction are exempted, they employ themselves in several kinds of manufactures: they spin cotton-yarn, weave fine cotton cloths, make calabashes, wooden vessels, plates, and dixies; likewise assaguys, and smiths' work in greater perfection than any other people on the coast. Whilft the men are thus employed, the women brew pito, and dress provifions, which, with their husbands' merchandize, they carry for sale to market. As to religion, Bofman is of opinion, that the piety of this country is founded upon no other principles than thofe of interest and superflition. In the latter, they exceed all other nations; for allowing, says he, the ancient heathens to value themselves upon thirty thousand deities, I dare venture to affirm that the natives of Whidah may lay just claim to four times that number. However, he believes that they have a faint idea of the one true God, to whom they attach omnipotence and ubiquity. One of their principal fetiches, or deities, is the snake, which they invoke in extreme wet, dry, or barren feafons, on all occasions relating to their government, civil policy, and cattle; in a word, on all the great difficulties and occurrences of life. This snake has a large round head, beautiful piercing eyes, a short pointed tongue, resembing a dart: its pace flyow and felement, except when it feizcs on its prey, then quick and rapid; its tail fharp andhort, its skin of an elegant smoothness, adorned with beautiful colours, upon a light-grey ground. It is amazincly tame and familiar, permitting itself to be approached, and even handled: they have a mortal antipathy to all venomous serpents: they attack them wherever they find them, as if they had pleasure in delivering mankind from their poison. The Europeans find no difficulty in familiarizing themselves to these inoffensive animals, with which they play without any dread or apprehension of danger. There is no fear of miftaking them for the poisonous ferpents, the colour and size sufficiently distinguishing them. The negroes entertain a notion that the firft progenitor of this race of snakes is still living, and growing to an enormous bulk. When the English firft settled in Whidah, the captain having unhitched his goods on fhore, the sailors foon found at night one of thofe snakes in their magazine, which they ignorantly killcd, and threw upon the bank, without dreaming of any bad confequences. The negroes, who foon discovered the fact, and had it confirmed by the acknowledgment of the English mariners, were not long in avenging the horrid impiy, by a method no lefs horrible. All the inhabitants of the province assembled; they attacked the English, maffacred them all to a man, and confumed their bodies and goods in the fire they had fet to the warehouse. Animals of all kinds are punished with death for injuring a snake. In 1697, a hog having had the precarious to destroy one of these deities, an order was flied for a general slaughter of swine throughout the kingdom, and the deflruction of the whole race was hardly prevented by the interposition of the king.

WHIDAH, a town of Africa, in the country of Whidah. N. lat. 6° 25'. E. long. 1° 24'.

WHIDBY'S ISLAND, an island in the Gulf of Georgia, near the west coast of America; about 36 miles long, and from 2 to 6 broad: fo named from Mr. Whidby, an officer under captain Vancouver. N. lat. 48° 10'. E. long. 237° 40'.

WHIDDY, an island in Bantry bay, in the county of Cork, Ireland, about 2 miles from the town of Bantry. It is a pleafant island of a triangular form, and the foil is exceflent.

WHIFF, in Ichtyology, the name of a fort of scounnder.

WHIFFLER of a Company, in London, a young free-
WHIG, in Rural Economy, a term provincially applied to acidulated whey, which is sometimes mixed with butter-milk and sweet herbs, to give it a flavour, when it becomes a good cooling summer beverage.

WHIGS, a party or faction in England, opposite to the Tories.

The origin of the names of these two mighty factions is very obscure. If some little trivial circumstance or adventure, which escapes the knowledge of mankind, gives name to a party, which afterwards becomes famous, polterry labours in vain to find the original of such a name; it searches the sources, forms conjectures, invents reasons, and sometimes, indeed, meets the truth, but always without knowing it assuredly.

Thus, in France, the Calvinists are called Huguenots; yet nobody was ever able certainly to assign the cause of that appellation. Whig is a Scotch term, and, some say too, an Irish word, literally signifying a bee. Tory is another Irish word, signifying a robber or highwayman.

Under the reign of King Charles II., while his brother, the Duke of York, was obliged to retire into Scotland, there were two parties formed in that country. That of the Duke was strongest, perfecuted the other, and frequently reduced them to fly into the mountains and woods; where those unhappy fugitives had often no other subsistence for a long time but cows' milk. Hence they called those their adversaries tories, q. d. robbers; and the tories, upbraiding them with their unhappiness, from the milk on which they lived, called them swhigs. From Scotland, the two names came over with the Duke into England.

Others give a different origin and etymology of the two words, for which see TORIES.

Bishop Burnet gives another etymology of the term swhigs. The south-west counties of Scotland, he says, are fupplied with currants from Leith; and from a word swigam, used by the carriers in driving their horses, all that drove were called swigmanours, and by contraction, swhigs.

He adds, that in the year 1648, after the news of the defeat of Duke Hamilton, who was charged with being a confederate with the malignants, or royal party, in England, the minifters animated their people to rise, and march to Edinburgh: who came up, marching each at the head of his parish, with an unheard-of fury, praying and preaching all the way as they came. The marquis of Argyle and his party came and headed them. This was called the swigmanour's inroad; and ever after, all that opposed the court were contemptuously called swhigs: and from Scotland the term was brought into England. Burnet's Hist. of Own Times, vol. i. p. 43:

For the distinguishing principles and characters of the whigs, see TORIES.

WHIMBRAL. See Scolopax Guarauna, and Pheopus.

WHIMSEY, Water, a machine consisting of a reservoir, or bucket of water, employed for raising another bucket, filled with coals or other materials, by means of a rope or chain, called round a cylinder or drum, or two drums of different sizes. When the bucket of water in this machine has reached the bottom of the pit or well, a valve is opened by striking against a pin, and lets out the water. In a machine of this kind, used in the Duke of Bridgewater's coal-works, the water descends thirty yards, and raises a smaller quantity of coals from a depth of sixty. In such cases, supposing the action to be single, and the stream of water to be employed during the descent of the reservoir, a considerable preponderance may be advantageously employed in giving velocity to the weights, provided that the machinery be not liable to injury from their impulce.

WHIN, in Botany. See Gorse.

WHIN, in Agriculture, a term sometimes applied to force; which, when cut in the lap and bruised in a proper way by flails, or in other modes, makes an excellent green food in winter for horses, which eat and thrive on it well. It is also useful in some measure to sheep-flock, as well as to bees. Its encroach on land may be safely and readily prevented by proper means being taken for the purpose. See Furze.

WHIN, in Gardening. See Ulex.

WHIN-After, in Agriculture and Planting, the ashes produced in burning whins; which have lately been found of great benefit in planting young trees, as well as on land for other purposes, promoting their growth in a very high degree. If the land to be planted be suitable, they are advised to be carefully spread and plunged in, if of quantity sufficient, over the whole field, otherwise only on the wet or colder spots or parts of it. But if the ground be such that it will not admit of plunging, the ashes should be mixed with part of the bell surface mould, to keep them from blowing abroad; and in the process of pitting, a little of this compound should be intimately mixed with the mould of each pit; previously distributing it in small heaps at convenient distances for facilitating the operation: and this extra trouble will be amply repaid by the progress the plants will make in consequence.

WHIN-Axe, in Agriculture, an instrument employed for extracting whins from land in many places. It is an implement that has one end like a common axe, with four inches of face; and the other like an adze, also with four inches of face; whereby the person using it, continuing in the same position by firmly turning it in the hand, can make cuts at right angles with one another, as circumstances may require. The head of the tool may be about eight inches in length, weighing from three to four pounds; and the handle, of ash, about four feet long.

WHIN, Petty, a name given to a species of ononis, or reed-harrow.

WHIN, Petty, in Gardening. See Genista.

WHINCHAT, in Ornithology, the English name of the Motacilla rubra of Linnaeus.

It is of the common size of the water-wagtail. Its head, neck, and back, are of a reddish-brown, with regular rows of black spots. Over each eye is a narrow white stroke, and beneath that a broad bed of black, extending from the bill to the hind part of the head; the breast is of a reddish-yellow; the belly paler; the quill-feathers are brown, edged with a yellowish-brown; the upper part of the wing is marked with two white spots; the lower part of the tail is white; the two middle feathers excepted, which are wholly black; the upper part of the other is of the same colour.

The colours are very uncertain in this bird, and it often much resembles the stone-chatter; but may always, by an accurate observer, be distinguished from that bird by the white spots in its wings, by the whiteness of the under part of its tail, and the white lines on its head.

The colours of the female are much less agreeable than those of the male; in lieu of the white and black marks on the cheeks is one broad pale brown one; and the white on the wings is in much less quantity than that of the male.

In the north of England, the whinchat is a bird of passage;
fage; in the south he continues the whole year. Ray and Pennant.

WHINE, a hunting term, used in respect of the cry of an otter.

WHINEBACH, in Geography, a town of Africa, on the Gold Coast. N. lat. 5° 30'. W. long. 1° 30'.

WHIN-STONE, in Geology, the provincial name given, in many parts of England and Scotland, to bafaltic rocks: it is also applied by miners to designate every kind of dark-coloured and hard unstratified rock, which refits the point of the pick. Many geologists in this country class all bafaltic or trap rocks under the term whin-stone. See Trap.

The substance which fills very large mineral veins is generally dark bafalt, or green-flone; hence these veins are most frequently called whin-dykes. These veins being harder than most of the rocks which they interfect, remain when the surface on each side of them is washed away, forming enormous walls extending into the sea, or rising above the level of the country in various parts of their course, and may often be traced for many leagues. They occur in the counties of Northumberland and Durham, and on the coasts of Scotland; and when broken down, they form reefs of rock or islands. The Farm îlands, off the coast of Northumberland, are parts of a bafaltic dyke. When whin-dykes cross rivers, they form ledges of rock consisting of fords; or, if very abrupt, they hold up the water on one side and form cascades. The Cleveland bafalt, or whin-dyke, described by Mr. Bakewell's Introduction to Geology, (see Veins, Mineral,) has been traced from the coast of Yorkshire seventy miles into the western part of Durham.

Under the article Mineral Veins, we have observed, that when whin-dykes interfect coal strata, they produce a change in the substance of the coal, and also of the other strata, similar to what might have been expected from a stream of melted lava; and we have recently observed a similar effect produced on primitive rocks of gneifs, in the vicinity of Aberdeen, by contact with a powerful whin-dyke. The whin-stone is also changed near its contact with the gneifs into a reddish horn-flone. In other parts, it is a dark granular bafalt or green-flone. The gneifs have lost its characteristic structure, and becomes porphyritic when near the whin-dyke. Between whin-dykes and the rocks which they interfect, there is sometimes a seam of soft argillaceous earth interposed, which is washed out when they are near the sea-coast, leaving the whin-stone like a wall placed between two perpendicular precipices. Sometimes the internal part of a whin-dyke will be composed of soft iron-clay; in other instances, the dyke will be composed of solid blocks or prisms of bafalt separated by similar clay. In some whin-dykes, the substance which fills them appears a compact and solid mass of whin-stone, which, however, will divide into four, five, or six Prisms, arranged horizontally.

These are perfectly similar to the perpendicular basaltic columns in structure, differing only in their position. There is a dyke traversing the bafaltic strata of the Giant's Causeway, on the coast of Antrim, in which this peculiarity of structure is remarkably displayed. It interfects beds of columnar bafalt, in which the columns are arranged with great regularity, and are perpendicular to the horizon; but the whole dyke is composed of small prisms of bafalt placed horizontally, or at right angles with the former. Some of these prisms do not exceed an inch in diameter, others are much larger; they are for the most part extremely regular, and are articulated or jointed.

It has been supposed with much probability, that the different arrangement of the columnar structure in the beds and in the dyke, is to be attributed to the different circum-

stances under which they were solidified. If the beds have once flowed as lava under the surface of the ocean, the bafalt would begin to cool and crystallize from the upper and lower surface. That this has probably been the case may be inferred from these beds resting on strata that contain marine organic remains, and which must, therefore, have been formed under the bed of the ocean.

The perpendicular dykes intersecting rocks already formed would begin to cool from the sides with which they were in contact, and the process would proceed laterally.

In some instances, we find whin-dykes principally composed of globular masses of stone separated by a large quantity of soft clay, and the globular masses are incrust with ochreous clay: probably the whole of the clay in such dykes has been formed from the decomposition of the basaltic masses by the action of water percolating them.

Whin-stone dykes present so many analogies with volcanic rocks in their composition, and the effects which they produce on the strata that they pass through, that we are led to infer their origin to the action of subterranean fire cracking the upper rocks and strata, and forcing the melted matter into the rent. Under the article Volcano, we have stated many instances of vall rents made in the earth, and filled by eruptions of lava; these rents filled with lava may be considered as whin-dykes of recent formation. This is further confirmed by the observations of M. Cordier, (see Volcanic Productions,) who has shown that the substance which fills both are essentially the same, being principally composed of felspar and augite, with iron-lannd and olivine. Whin-stone not only occupies the cavities of perpendicular dykes; but it appears to have been, in many instances, found laterally between the regular strata, producing singular conlocations and dislocations, and almost always effecting a change in the substance of the rock with which it comes in contact. Sometimes it produces a change in the form of the bed or stratum which it has passed through, breaking it into distinct masses, or bending it in different directions, or enveloping large parts of it in the bafalt or whin-stone. Of this a remarkable instance is described in the third volume of the Transactions of the Geological Society, occurring on the north coast of Ireland, in the county of Antrim. (See Plate IV. fig. 4. Geology.) a a represents a bed of chalk singularly bent, and completely enveloped in the bafalt which forms a part of the basaltic range extending from the Giant's Causeway.

The beds of chalk and the other strata on this coast are frequently intersected by whin-dykes, and a most remarkable change is observed in the structure of the chalk in the vicinity of these dykes. In immediate contact with the whin-stone, and to a considerable distance on each side, the chalk is converted into marble, having the granular texture of primitive lime-flone, or what the French call calcaire facaroid, from its resemblance to the grain of loof-fugar, (see Plate IV. fig. 5. Geology,) which represents two adjoining whin-dykes a b, intersecting the chalk c. The dyke a is thirty feet in width, the dyke b twenty feet, and the intervening mafs of chalk twenty feet. The mafs of chalk between the two large dykes is intersected in a zigzag direction by a smaller dyke. To a certain distance from the whin-stone, the chalk is perfectly crystalline, but it gradually approaches to the character of the chalk at a greater distance from the dyke. In various parts of the world we observe trap or whin-stone occurring in apparently regular beds, either covering stratified rocks, or interposed between them; such have been called by the Wernierian geologists flintz trap-rocks, and their occurrence in this position has been urged as an argument for the aqueous formation of such
such rocks. But it is well known to practical miners, that these beds are much more variable in their thickenss than the regular stratæ, sometimes measuring twenty, thirty, or forty feet or more; and in other parts, the same bed will diminish to a few feet, or entirely terminate. In the isle of Skye, according to the description of Dr. Macculloch, in the third and fourth volumes of the Transactions of the Geological Society, the whin-flone is spread over the regular stratæ in beds, or forms detached conical caps. It is also to be seen interposed between the stratæ, and may be traced for more than a mile in continuous regular beds; but, says Dr. Macculloch, "there are no inclusions where the alternating beds of trap detach veins or dykes from the lower to the upper beds; or the trap, quitting the interval between two given beds of lime-flone or sand-flone, makes its way across the one immediately above or below, and then proceeds with a regularity as great between some other pair of proximate stratæ." And he adds, "I have no doubt, could such extensive exposure of the stratæ be offerent procured, all the inclusions of supposed alternating trap with regular stratified rocks would prove similar to the above." These observations, which might be confirmed by numerous other instances, tend to prove, that whin-dykes, and many of the interposed stratæ of whin-flone, are of posterior formation to the rocks in which they occur, and have been forced between the stratæ in a fluid state, and subsequently consolidated. The whin-dykes, or perpendicular veins, are the channels through which the basalt flowed up; but by superincumbent pressure, it has been driven laterally at different elevations. As beds of whin-flone occur in different rocks, it is probable, and almost certain, that they have had different epochs of formation; and of course some of the beds of whin-flone, which are covered by stratified rocks containing many organic remains, may have flowed as beds of lava under the ocean, and have been again covered with other stratæ, on which again a second torrent of lava burfting from below may have flown and formed an upper bed. It is well known that the beds of toad-flone in Derbyshire, which are interposed between the mountain lime-flone of that district, cut off the metallic veins; but they are found again on sinking through the toad-flone into the lower lime-flone. This flone, which varies from a hard, compact whin-flone or trap, to a soft amygdaloidal wacke, (see Toad-Stone and Wacke,) is supposed, by Mr. Whitehurst, to have flowed between the beds of lime-flone after the formation of metallic veins; and, could we admit the hypothesis, it would satisfactorily explain the cause of their disapperance in the toad-flone. But though there are many inclusions of the vein entirely disapperacing in the latter rock, there are others in which a narrow vein passes through the toad-flone, though it is never productive of ore, being filled with calcareous spar, and a few particles only of galine. The occurrence of these veins in the toad-flone proves that this rock was not found between the lime-flone after the formation of metallic veins. Some softer whin-flone rocks, of the species called by mineralogists wacke, (see Wacke,) contain cavities lined, or partly filled with zeolites, agates, or calcarceous spar; and some of these rocks envelope marine organic remains, particularly a rock of this kind near Berykley in Gloucestershire. The Euganean mountains are composed of a similar rock, and also contain marine remains. These rocks have probably been formed by muddy eruptions of sub-marine volcanoes, similar to what take place from some of the American volcanoes at the present time; and it is not improbable but that these two modes of formation may have given rise to that diversity which we observe in rocks of this class, the softer and more earthy being the products of Vol. XXXVIII.

**W H I**

**Aqueous and muddy eruptions, and the harder and more crystalline the products of igneous fusion. See Trap, and Volcanic Products.**

**WHIP, or Whip-Staff, in a Ship, a piece of timber in form of a strong staff, fastened into the helm, for the steerer, in small ships, to hold in his hand; thereby to move the rudder, and direct the ship.**

**WHIP denotes also a sort of small tackle, formed by the communication of a rope either with a single immovable block, or with two blocks, one of which is fixed, and the other moveable. It is generally used to hoist light bodies, as empty casks, &c. out of a ship's hold, which is accordingly called whipping them up. Falconer.**

To **whip** is to tie a piece of pack-thread, spun-yarn, &c. about the end of a rope, to prevent it from being untwisted and unloosed.

**Whip, in Rural Economy, the lash attached to flexible rods or other substances and contrivances, for the purpose of driving teams.**

**Whip-Grafting, in Gardening, a particular mode of performing the operation. A sort of root-whip-grafting is advised by Agricola, in which a graft or scion is taken from a young tree, and a small piece of the root of another tree of the same kind, or like it; or otherwise, pieces of roots cut off from other trees in transplanting: these are whip-grafted together, taking care that the two but ends of the graft and root be united, and that the resid of the root join that of the graft; then plant the root with the part of the scion underground. See Grafting, and Stocks, Apple-grafting in.**

**Whip-Poor-Will. See Caprimulgus Virginianus.**

**Whip-Rein, in Agriculture, a term used to signify a rein formed of cord or leather, by which a plough or other sort of team is directed in working. See Rein.**

**Whip-Rein-Plough, a term applied to a small plough, drawn by two horses, or oxen, which are guided and directed by proper reins of this sort, and so made as to serve the ploughman in the way of a whip, in driving them while he holds the plough.**

**Whip-Saw. See Whip-Saw.**

**WHIPLADE, in Husbandry, a term used by the farmers in some places for a particular sort of cart, whose hinder part is made up of boards after the manner of a dung-cart, having also a head of boards, and a shamble over the thills; this head being so as either to be taken out or left in. The cart may be indifferently used to carry dung or other things; dung when the head is in, and corn, &c. when it is taken out.**

**WHIPPANY, in Geography, a town of New Jersey; 20 miles W.N.W. of New York.**

**WHIPPER. See Fishing.**

**WHIPPING, a term used by Anglers, when they fasten a line to the hook or rod.**

The word is also taken for the casting in of the hook, and drawing it gently on the water.

**Whipping, in Law, denotes an ignominious punishment inflicted on perfons guilty of petty larceny, &c.**

**Whipping Wheat, in Agriculture, a term applied to the practice in some of the northern districts, by which the wheat-crops are lashed or whipped out on a wooden or wattle frame-work contrived for the purpose. The former is constructed by nailing two or more thick boards in a flaiting manner, to the height of about two and a half, or three feet, on a sort of frame of suitable strengthe, supported by legs, having the upper part a little rounded, and made smooth. This, which is termed the whipping or lashing frame, is placed**
placed in some convenient situation, so as to prevent the grain from flying about during the operation, which is then begun. Where the latter contrivance is made use of, the frame is woven with strong flitches, in the manner of a hurdle, being placed in the same situation when used.

The process is performed by taking large handfuls of the corn in the straw by the butt end, and striking the top or ear-ends over the upper part of the frame, so as to force out the grain from the ears of the top part, without breaking the straw, which in this way becomes much better for thatch, and at the same time the grain is less injured than by the flail method of threshing it out. The butt parts of the straw are sometimes afterwards thrashed over, in order to get out any wheat that may have been left in the short ears. This is an excellent mode of providing feed-wheat, as the finest grain is chiefly procured.

And it is suggested, too, as a particularly good method in cafes where wheat is infected with the smut, as during the operation of threshing, the flail breaks the smut-balls, and reduces them to a powdery flake, which causes the good wheat to have a blacker appearance than would otherwise be the case when ground. It may likewise be used to advantage with other sorts of grain in some cafes.

The above is also a term sometimes applied in the northern districts, to the practice of striking it over a flake or other such contrivance, in order to get out the grain, and leave the straw in an unbroken flake. In this way it is sometimes termed flaking. It is an excellent practice in getting out this sort of grain in many points of view, when on a small scale, but it is not well suited to large concerns. See Thrashing.

WHITTLE-TREE, a term used to signify the bar or wooden part of the contrivance by which a horse or team is attached to a plough, harrow, or any other sort of implement of these kinds. They are of different sizes and forms, according to the nature of the teams and other circumstances. See SWINGLE-TREE, Indented.

WHIPSTITCH, a term not unfrequently used in ploughing to signify a sort of half-ploughing, or what in many places is termed raftering. It is principally made use of for keeping the land more dry and healthy in the winter season. See RAFTERING.

WHIPSTITCHING, the practice of working tillage-land in somewhat the raftering manner. It is a method often employed for turning up flubbles of the wheat and other kinds in the winter time, instead of making a fallow. The best mode of doing it in this intention is first to make what is called a whiplitch, rafter, or sort of half-ploughing of the land; and that when come back again to the same furrow, to turn them both over; the top parts of both furrows being thus turned in the middle, which leaves the space of four inches betwixt each furrow; then ploughing the land across the old furrows. If land lies ever so wet in winter, by ploughing in this manner, it may be kept dry and in a healthy state. It is necessary, too, to strike up the old furrows every day before leaving the ground; and to let the main drains be kept well open to receive the water from the furrows in the land; by this means, the frost will be admitted four inches deeper than in the case of a flat fallow-work.

This mode of tillage is that which is sometimes called double whipstitching in some districts and places.

Some prefer it before all other methods for winter-tillage, as it brings the land into much better condition for cultivation than twice fallowing.

WHIT SYLLABUB. See SYLLABUB.

WHIRL-POOL, an eddy, vortex, or gulf, where the water is continually turning round. See GULPH, EDDY, VORTEX, &c.

These in rivers are very common, from various accidents, and are usually very trivial, and of little consequence. In the sea they are more rare, but more dangerous. Sibbald has related the effects of a remarkable marine whirlpool among the Orcades, which would prove very dangerous to strangers, though it is of no consequence to the people who are used to it. This is not fixed to any particular place, but appears in various parts of the limits of the sea among those islands. Wherever it appears, it is very furious, and boats, &c. would inevitably be drawn in and perish with it; but the people who navigate them are prepared for it, and always carry an empty vessel, a log of wood, or large bundle of straw, or some such thing, in the boat with them; as soon as they perceive the whirlpool, they toss this within its vortex, keeping themselves out; this substance, whatever it be, is immediately received in the centre, and carried under water; and as soon as this is done, the surface of the place where the whirl-pool was becomes smooth, and they row over it with safety; and in about an hour they see the vortex begin again in some other place, usually at about a mile distant from the first. Sibbald's Prod. Hist. Scot.

WHIRLING-TOBE, in Military Antiquities, a machine contrived for exhibiting and demonstrating the principal laws of gravitation, and of the planetary motions in curvilinear orbits. A A (Plate XXI. fig. 13. Astronomy) is a strong frame of wood, B a winch fixed on the axis C of the wheel D, round which is the catgut-fitting F, which also goes round the small wheels G and K, crossing between them and the great wheel D. On the upper end of the axis of the wheel G, above the frame, is fixed the round board d, to which may be occasionally fixed the bearer M S X. On the axis of the wheel H is fixed the bearer N T Z, and when the winch B is turned, the wheels and bearers are put into a whirling motion. Each bearer has two wires, W X and Y Z, fixed and feretive tight into them at the ends by nuts on the outside; and when the nuts are unscrewed, the wires may be drawn out in order to change the balls U, V, which slide upon the wires by means of brass loops fixed into the balls, and preventing their touching the wood below them. Through each ball there passes a silk line, which is fixed to it at any length from the centre of the bearer to its end by a nut-ferew at the top of the ball; the flanks of the screw going into the centre of the ball, and pressing the line against the under side of the hole which it goes through. The line goes from the ball, and, under a small pulley fixed in the middle of the bearer; then up through a socket in the round plate (S and T) in the middle of each bearer; then through a slit in the middle of a square top (O and P) of each tower, and going over a small pulley on the top comes down again the same way, and is at last fastened to the upper end of the socket fixed in the middle of the round plate above-mentioned. Each of these plates, S and T, has four round holes near their edges, by which they slide up and down upon the wires which make the corner of each tower. The balls and plates being thus connected, each by its particular line, it is plain that if the balls be drawn outward, or towards the ends M and N of their respective bearers,
bearers, the round plates S and T will be drawn up to the top of their respective towers O and P.

There are several brass weights, some of two, some of three, and others of four ounces, to be occasionally put within the towers O and P, upon the round plates S and T; each weight having a round hole in the middle of it, for going upon the sockets or axes of the plates, and being fit from the edge to the hole, that it may slip over the line which comes from each ball to its respective plate.

For a specimen of the experiments which may be made with this machine, we shall subjoin the following.

1. Removing the bearer M X, put the loop of the line b, to which the ivory ball a is fastened, over a pin in the centre of the board d, and turn the winch B; and the ball will not immediately begin to move with the board, but, on account of its inactivity, endeavour to remain in its state of rest. But when the ball has acquired the same velocity with the board, it will remain upon the same part of the board, having no relative motion upon it. However, if the board be suddenly stopped, the ball will continue to revolve upon it, until the friction thereof stops its motion; so that matter retains every change of state, from that of rest to that of motion, and vice versa.

2. Put a longer cord to this ball; let it down through the hollow axis of the bearer M X and wheel G, and fix a weight to the end of the cord below the machine; and this weight, if left at liberty, will draw the ball from the edge of the whirling-board to its centre. Draw off the ball a little from its centre, and turn the winch; then the ball will go round and round with the board, and gradually fly farther from the centre, raising up the weight below the machine; and thus it appears that all bodies revolving in circles, have a tendency to fly off from these circles, and must be retained in them by some power proceeding from or tending to the centre of motion. Stop the machine, and the ball will continue to revolve for some time upon the board; but as the friction gradually stops its motion, the weight acting upon it will bring it nearer and nearer to the centre in every revolution, till it brings it quite thither. Hence it appears, that if the planets met with any resistance in going round the sun, its attractive power would bring them nearer and nearer to it in every revolution, till they fell into it.

3. Take hold of the cord below the machine with one hand, and with the other throw the ball upon the round board as it were at right angles to the cord, and it will revolve upon the board. Then, observing the velocity of its motion, pull the cord below the machine, and thus bring the ball nearer the centre of the board, and the ball will be seen to revolve with an increasing velocity, as it approaches the centre; and thus the planets which are nearest the sun perform quicker revolutions than those which are more remote, and move with greater velocity in every part of their respective circles.

4. Remove the ball a, and apply the bearer M X, whose centre of motion is in its middle at w, directly over the centre of the whirling-board d. Then put two balls (V and U) of equal weights upon their bearing wires, and having fixed them at equal distances from their respective centres of motion w and z upon their silk cords, by the screw-nuts, put equal weights in the towers O and P. Last, put the catgut-strings E and F upon the grooves G and H of the small wheels, which, being of equal diameters, will give equal velocities to the bearers above, when the winch B is turned; and the balls U and V will fly off toward M and N, and raise the weights in the towers at the same instant. This shews that when bodies of equal quantities of matter revolve in equal circles with equal velocities, their centrifugal forces are equal.

5. Take away these equal balls, and put a ball of six ounces into the bearer M X, at a sixth part of the distance w z from the centre, and put a ball of one ounce into the opposite bearer, at the whole distance w z; and fix the balls at these distances on their cords, by the screw-nuts at the top: then the ball U, which is six times as heavy as the ball V, will be at only a sixth part of the distance from its centre of motion; and consequently will revolve in a circle of only a sixth part of the circumference of the circle in which V revolves. Let equal weights be put into the towers, and the winch be turned; which (as the catgut-string is on equal wheels below) will cause the balls to revolve in equal times: but V will move six times as fast as U, because it revolves in a circle of six times its radius, and both the weights in the towers will rise at once. Hence it appears, that the centrifugal forces of revolving bodies are in direct proportion to their quantities of matter multiplied into their respective velocities, or into their distances from the centres of their respective circles.

If these two balls be fixed at equal distances from their respective centres of motion, they will move with equal velocities; and if the tower O has six times as much weight put into it as the tower P has, the balls will raise their weights exactly at the same moment: i.e. the ball U, being six times as heavy as the ball V, has six times as much centrifugal force in describing an equal circle with an equal velocity.

6. Let two balls, U and V, of equal weights be fixed on their cords at equal distances from their respective centres of motion w and x; and let the catgut-string E be put round the wheel K (whose circumference is only half that of the wheel H or G) and over the pulley g to keep it tight, and let four times as much weight be put into the tower P, as in the tower O. Then turn the winch B, and the ball V will revolve twice as fast as the ball U in a circle of the same diameter, because they are equi-distant from the centres of the circles in which they revolve; and the weights in the towers will both rise at the same instant, which shews that a double velocity in the same circle will exactly balance a quadruple power of attraction in the centre of the circle; for the weights in the towers may be considered as the attractive forces in the centres, acting upon the revolving balls; which, moving in equal circles, are as if they both moved in the same circle. Whence it appears, that if bodies of equal weights revolve in equal circles with unequal velocities, their centrifugal forces are as the squares of the velocities.

7. The catgut-string remaining as before, let the distance of the ball V from the centre x be equal to 2 of the divisions on its bearer; and the distance of the ball U from the centre w be 3 and a fifth part; the balls themselves being equally heavy, and V making two revolutions by turning the winch, whilst U makes one; so that if we suppose the ball V to revolve in one moment, the ball U will revolve in two moments, the squares of which are 1 and 4; therefore, the square of the period of V is contained 4 times in the square of the period of U. But the distance of V is 3, the cube of which is 27, and the distance of V is 32, the cube of which is 32 very nearly, in which S is contained 3 times; and therefore the squares of the periods of V and U are to one another as the cubes of their distances from x and w, the centres of their respective circles. And if the weight in the tower O be 4 ounces, equal to the square of 2, the distance of V from the centre x; and the weight in the tower P be 10 ounces, nearly equal to the square of 3, the distance
distance of U from \( w \); it will be found, upon turning the machine by the winch, that the balls U and V will raise their respective weights at very nearly the same instant of time. This experiment confirms the famous proposition of Kepler, viz. that the squares of the periodic times of the planets round the sun are in proportion to the cubes of their distances from it; and that the sun's attraction is inversely as the square of the distance from his centre.

8. Take off the rings E from the wheels D and H; and let the rings F remain upon the wheels D and G. Then throw away also the bearers MX from the whirling-board d, and instead of it put on the machine A B (Plate XXI. fig. 14, Aëronomy), fixing it to the centre of the board by the pins c and d, so that the end e may rise above the board to an angle of 30 or 40 degrees. On the upper part of this machine, there are two glass tubes a and b, close stopped at both ends; each tube being about three-quarters full of water.

In the tube a is a little quicksilver, which naturally falls down to the end a in the water; and in the tube b is a small cork, floating on the top of the water, and small enough to rise or fall in the tube. While the board b with this machine upon it continues at rest, the quicksilver lies at the bottom of the tube a, and the cork floats on the water near the top of the tube b. But, upon turning the winch and moving the machine, the contents of each tube will fly off towards the uppermost ends, which are farthest from the centre of motion: the heaviest with the greatest force. Consequently, the quicksilver in the tube a will fly off quite to the end f, occupying its bulk of space and excluding the water, which is lighter than itself: but the water in the tube b, flying off to its higher end e, will exclude the cork from that place, and cause it to descend toward the lowest end of the tube; for the heavier body, having the greater centrifugal force, will possess the upper part of the tube, and the lighter body will keep between the heavier and the lower parts.

This experiment demonstrates the absurdity of the Cartesian doctrine of vortices: for, if the planet be more dense or heavy than its bulk of the vortex, it will fly off in it farther and farther from the sun; if less dense, it will come down to the lowest part of the vortex, at the sun: and the whole vortex itself, unless prevented by some obstacle, would fly quite off, together with the planets.

9. If a body be so placed upon the whirling-board of the machine (fig. 13.) that the centre of gravity of the body be directly over the centre of the board, and the board be moved ever so rapidly by the winch B, the body will turn round with the board, without moving from its middle: for, as all parts of the body are in equilibrium round its centre of gravity, and the centre of gravity is at rest in the centre of motion, the centrifugal force of all parts of the body will be equal at equal distances from its centre of motion, and therefore the body will remain in its place. But if the centre of gravity be not placed over the centre of the board, and the machine be turned swiftly round, the body will fly off towards that side of the board on which its centre of gravity lies. Then, if the wire C (fig. 15.) with its little ball B be taken away from the semi-globe A, and the flat side e of the semi-globe be laid upon the whirling-board, so that the centres may coincide; then if the board be turned over so quickly by the winch, the semi-globe will remain where it was placed: but if the wire C be screwed into the semi-globe at d, the whole becomes one body, whose centre of gravity is at or near d. Fix the pin c in the centre of the whirling-board, and let the deep groove b cut in the flat side of the semi-globe be put upon the pin, so that the pin may be in the centre of A (see fig. 16, where the
trough and balls will go round their centre of gravity, so as neither of them will fly off; because, on account of the equili-

trium, each ball detains the other with an equal force acting against it. But if the ball E be drawn a little more towards the end of the trough at A, it will remove the centre of gravity towards that end from the centre of motion; and then, upon turning the machine, the little ball E will fly off, and strike with a considerable force against the end A, and draw the great ball B into the middle of the trough. Or, if the great ball D be drawn towards the end B of the trough, so that the centre of gravity may be a little towards that end from the centre of motion, and make the machine turned by the winch; the great ball D will fly off, and strike violently against the end B of the trough, and bring the little ball E into the middle of it. If the trough be not made very strong, the ball D will break through it.

12. Mr. Ferguson has explained the reason why the tides rife at the same time on opposite sides of the earth, and consequently in opposite directions, by the following new ex-

periment on the whirling-table. For this purpose, let a b c d (fig. 19.) represent the earth, with its side e turned toward the moon, which will then attract the water so as to raise them from e to g, and in order to show that they will rife as high at the same time on the opposite side from a to e, let a plate A B (fig. 20.) be fixed upon one end of the flat bar D C, with such a circle drawn upon it as a b c d (fig. 19.) in order to represent the round figure of the earth and sea; and an ellipse as e f g h to represent the swelling of the tide at e and g, occasioned by the influence of the moon. Over this plate A B suspend the three ivory balls e, f, g, by the silk lines b, i, k, fastened to the tops of the crooked wires H, I, K, so that the ball at e may hang freely over the side of the circle e, which is farthest from the moon M at the other end of the bar; the ball at f over the centre, and the ball at g over the side of the circle g, which is nearest the moon. The ball f may represent the centre of the earth, the ball g water on the side next the moon, and the ball e water on the opposite side. On the back of the moon M is fixed a short bar N parallel to the horizon, and there are three holes in it above the little weights p, q, r. A silk thread e is tied to the line b, close above the ball g, and passing by one side of the moon M goes through a hole in the bar N, and has the weight p hung to it. Such another thread n is tied to the line i, close above the ball f, and passing through the centre of the moon M and middle of the bar N, has the weight q hung to it, which is lighter than the weight p. A third thread m is tied to the line h, close above the ball e, and passing by the other side of the moon M, through the bar N, has the weight r hung to it, which is lighter than the weight q. The use of these three unequal weights is to represent the moon's unequal attraction at different distances from her, so that if they are left at liberty, they will draw all three balls towards the moon with different degrees of force, and cause them to appear as in fig. 21, in which case they are evidently further from each other than if they hung freely by the perpendicular lines b, i, k. Hence it appears, that as the moon attracts the side of the earth which is nearest her with a greater degree of force than she does the centre of the earth, she will draw the water on that side more than the centre, and cause it to rife on that side; and as she, draws the centre more than the opposite side, the centre will recede farther from the surface of the water on that opposite side, and leave it as high there as she raised it on the side next her. For, as the centre will be in the middle between the tops of the opposite elevations, they must of course be equally high on both sides at the same time.

However, upon the supposition, the earth and moon would soon come together; and this would be the case, if they had not a motion round their common centre of gravity, to produce a degree of centrifugal force, sufficient to balance their mutual attraction. Such motion they have; for as the moon revolves in her orbit every month at the distance of 240,000 miles from the earth's centre, and of 234,000 miles from the centre of gravity of the earth and moon, the earth also goes round the same centre of gravity every month at the distance of 6000 miles from it, i.e. from it to the centre of the earth. But the diameter of the earth being, in round numbers, 8000 miles, its side next the moon is only 2000 miles from the common centre of gravity of the earth and moon, its centre 6000 miles from it; and its farthest side from the moon 10,000 miles. Consequently the centrifugal forces of these parts are as 2000, 6000, and 10,000; i.e. the centrifugal force of any side of the earth, when it is turned from the moon, is five times as great as when it is turned toward the moon. And as the moon's attraction, expressed by the number 6000, at the earth's centre, keeps the earth from flying out of this monthly circle, it must be greater than the centrifugal force of the waters on the side next her; and consequently, her greater degree of attraction on that side is sufficient to raise them; but as her attraction on the opposite side is less than the centrifugal force of the waters there, the excess of this force is sufficient to raise the water just as high on the opposite side.

To prove this experimentally, let the bar D C with its furniture be fixed on the whirling-board of the machine, (fig. 14.) by pushing the pin P into the centre of the board; which pin is the centre of gravity of the whole bar with its three balls e, f, g, and moon M. Now, if the whirling-board and bar be turned slowly round by the winch, till the ball f hangs over the centre of the circle, as in fig. 22, the ball g will be kept towards the moon by the heaviest weight p (fig. 20.), and the ball e, on account of its greater centrifugal force, and the lea weight r, will fly off as far to the other side, as in fig. 22. And thus, whilst the machine is kept turning, the balls e and g will hang over the ends of the ellipse f k. So that the centrifugal force of the ball e will exceed the moon's attraction just as much as her attraction exceeds the centrifugal force of the ball g, whilst her attraction just balances the centrifugal force of the ball f, and makes it keep in its circle. Hence it is evident, that the tides must rise to equal heights at the same time on opposite sides of the earth. See Ferguson's Lectures on Mechanics, lec. 2., and Defag. Ex. Phil. vol. i. lec. 5.

WHIRL-WIND, a wind that rises suddenly, and is exceedingly rapid and impetuous when risen, but is soon spent. In this case, the gusts of wind proceed from different quarters at the same time, and meet in a certain place, where the air acquires a circular, or rotatory, or screw-like motion, either ascending or descending, as it were, round an axis, which axis is sometimes stationary, and at other times moves on in a particular direction. This phenomenon, called a whirl-wind, gives a whirling motion to dust, sand, water, part of a cloud, and sometimes even to bodies of great weight and bulk; carrying them either upwards or downwards, and lastly, scattering them about in different directions.

There are divers sorts of whirl-winds, distinguished by their peculiar names: as, the presser, sphe, turba, exhydra, and ecrephies.

The
The _preyfer_ is a violent wind breaking forth with flashes of lightning. This is rarely observed; scarcely ever without the _euphysis_. Seneca says, it is a _typho_, or _turbo_, kindled or ignited in the air.

The _euphysis_ is a sudden and impetuous wind, breaking out of some cloud; frequent in the Ethiopic sea, particularly about the Cape of Good Hope. The seamen call them _travaden_.

The _exhufia_ is a wind bustling out of a cloud, with a great quantity of water. This only seems to differ, in degree, from the _euphysis_, which is frequently attended with thunderers.

A _typho_, or _vortex_, most properly called a _whirlwind_, or _hurricane_, is an impetuous wind, turning rapidly every way, and sweeping all round the place. It frequently descends from on high. The Indians call it _oruanca_; the Turks, _&c._ _aliphant_. It is frequent in the Eastern ocean, chiefly about Siam, China, &c. and renders the navigation of those parts exceedingly dangerous.

Dr. Franklin, in his Physical and Meteorological Observations, read to the Royal Society in 1756, supposes a whirl-wind and a water-spout to proceed from the same cause; their only difference being, that the latter paffes over the water and the former over the land. This opinion is corroborated by the observations of M. de la Pryme, and many others, who have remarked the appearances and effects of both to be the same. They have both a progressive as well as a circular motion; they generally rife after calms and great heats, and occur most frequently in the warmer latitudes; the wind blows every way from a large surrounding space both to the water-spout and whirl-wind; and a water-spout has, by its progressive motion, paffed from the sea to the land, and produced all the phenomena and effects of a whirl-wind; so that there is no reason to doubt their being meteors arising from the same general cause, and explicable upon the same principles, furnished by electrical experiments and discoveries. See _Hurricane_, and _Water-Spout_.

For Dr. Franklin's ingenious method of accounting for both these phenomena, see his Letters and Papers, &c. vol. i. p. 194, &c. p. 216, &c.

WHISKET, or Whisk, in Rural Economy, a term often used provincially to signify a basket, especially in the northern counties. See _Basket_.

WHISKY, a term signifying water, and applied in the Highlands and islands of Scotland and in Ireland to strong water or distilled liquor. The spirit drank in the North is drawn from barley, and is said to be preferable to any English malt-brandy: it is strong, but not pungent, and free from the repulsive taint or smell.

WHISPERING. See HEARING, ATTENTION, &c.

WHISPERING-PLACE, such as domes and gallerics, depend on this principle, that the voice being applied to one end of an arch, easily paffes by repeated reflections to the other.

Thus, let A B C (Plate XV. _Pneumatics_, fig. 8.) represent the segment of a sphere; and suppose a low voice uttered at D, the vibrations extending themselves every way, some of them will impinge upon the points E, E, &c. and thence be reflected to the points F, F, &c. thence to G, G, &c. till at last they meet in C; where, by their union, they cause a much stronger sound than in any part of the segment whatever, even at D the point whence they first proceeded.

Accordingly, all the contrivance in a whispering-place is, that near the person who whispers there be a smooth wall, arched either cylindrically, or elliptically; in which case he will be heard distinctly by another person, who places his ear pretty near the wall on the opposite side. A circular arch will do, but not so well. It is demonstrated by all the writers on CoNics (which _see_), that if from any point in the circumference of an ellipse two lines be drawn to the foci, those lines make equal angles with one curve at that point. Consequently, the sound which is produced in one focus of an elliptical chamber, and is reflected from the wall to the other focus, makes all the angles of incidence equal to the angles of reflection respectively. Hence that focus is the place where the sound is best heard.

Places famed for the conveyance of whispers are, the prison of Dionysus at Syracuse, which increafed a soft whisper to a loud noise; the elap of one's hand to the sound of a cannon, &c.; the aqueducts of Claudius, which carried a voice sixteen miles; and divers others enumerated by Kircher in his Phosphoria.

The most considerable in England are, the dome of St. Paul's, London, where the ticking of a watch may be heard from side to side; and a very easy whisper be fent all round the dome; this Dr. Derham found to hold not only in the gallery below, but above upon the scaffold, where a whisper would be carried over one's head round the top of the arch, though there be a large opening in the middle of it into the upper part of the dome; and the famous whispering-place in Gloucester cathedral, which is no other than a gallery at the east end of the choir, leading from one side of it to the other. It consists of five angles and fix fides, the middlemost of which is a naked window; yet two whisperers there hear each other at the distance of twenty-five yards. See Birch's Hift. of the Royal Society, vol. i. p. 120. See _Echo_.

WHIST, or Whisk, a well-known game at cards. Mr. T. Matthews, one of the last and moft approved writers on the game of whift, has published (1816) a tenth edition of his "Advice to the Young Whift Player, &c." in which he has comprized, under the detail of 108 maxims, fuch instructions as are neceffary to be observed by thofe who wish to play this game with skill and fuccefs. It would far exceed our limits, if we attempted to follow him in this detail; and an abridgment, if it were practicable, would be of little ufe; nor indeed is it neceffary, as thofe who are defirous of acquiring a knowledge of the minutiae of the game will confer the author, whose "Advice" may be easily and cheaply procur'd. We shall, however, felect fome of thofe instructions that are the moft important, and subjoin thofe laws of the game that ferve to prevent or settle difputes among players.

The following maxims comprehend fome instructions that relate to leads, to which we have annexed fome other directions that are immediately connected with them. It is highly neceffary, fays Mr. M., to be correc in leads. When a good player plays an eight, and then a feven, it may be known that he leads from a weak hand; and the contrary, when he plays the feven firft: the cafe is the fame with a tray or a deuce.

Good players never lead a nine or ten, but for one of these reafons:

1. The safest leads are thofe that are furnished by sequences of threc or more cards; _in which cafe the player is advised to lead the highest, and to put on the lowest to his partner's lead, and to put the highest on his adversary's_; and with a triangle to the king and feveral others, to begin with...
WHIST.

with the knife. If he has no sequences, he is instructed to lead from his most numerous suit; if strong in trumps, to lead rather from one headed by a king than a queen, but with three or four small trumps, Mr. Matthews prefers leading from a single card to a long weak suit. But the players of the old school never lead from a single card without fix trumps. In some cases, Mr. M. observes, this may be occasionally done with very great, though not certain, advantage; e.g., when A has four small trumps, ace, queen, &c. of the second suit; king, knave, &c. of a third; and a single card of the fourth. To lead from three cards, unless in sequences, is bad play, and only proper when you have reason to think it is your partner's suit, and then lead off the highest. Unless, says Mr. M., you have a strong suit yourself, or have reason to suppose that your partner has one, do not trump out unless you have fix trumps. It is generally right to return your partner's lead in trumps, unless he leads a nine or ten, called an equivoque card, because it is led with propriety, both from strong and weak suits.

2. With ace, king, knave, and three small trumps, play the ace and king; with only two, the king, and wait for the finesse of the knave. In other suits, without great strength in trumps, or with the hopes of a particular point, do not wait for the finesse.

3. Ace, king, and five others, lead the ace in all suits. With four or less, the lowest, if trumps. In other suits always the ace, unless all the trumps remaining are with you and your partner; in this case, a small one.

Mr. M. advises not to lead trumps merely because an honour is turned up on your left, nor to be deterred from it if on your right-hand; either, he says, is proper, if the circumstances of your hand require trumps to be led; but neither otherwise.

It is equally advantageous to lead up to an ace as through an ace; not so much fo to a king, and disadvantageous to the queen turned up.

When cards are nearly equal, says this author, the point to which all the manoeuvres of good whist players tend, is to establish a long suit, and to prefer the last trump, to bring it into play, and to frustrate the same play of their adversaries. With an honour (or even a ten), with three other trumps, by well managing them, you have a right to expect succeds. In this case, do not over-trump your right-hand adversary early in the hand; but throw away a losing card, by which, there remaining but twelve trumps, your own hand is strengthened, and your partner has the tenace, in any suit that is led; whereas, had you over-ruffed, you would have given up the whole game, to secure one trick. But there are reasons for breaking this rule: - 1st. If your left-hand adversary has thrown a decided great hand in trumps, (in which case make your tricks while you can,) or 2d. If your partner decidedly means to force you,—to understand if this is the case, you are to observe, if your partner plays the winning or losing card of the suit you have refused. If the former, it is by no means clear he means to force you, and you play your own game. If the latter, you are to suppus he strong in trumps, and depend on this, to protect your long suit: a due reflection on this will convince you of the value of that maxim, which enjoins you never to play a strong game with a weak hand, or vice versa.

It is difficult to judge when to lead trumps. The following situations will affhit the beginner to reason, and in general direct him properly:

1st. With fix trumps, on supposition your partner has a strong suit.

2d. If strong in other suits, though weak in trumps yourself.

3d. If your adversaries are playing from weak suits.

4th. If your adversaries are at the point of eight, and have no honour, or probability of making a trump by a ruff.

With king, queen, ten, &c. in all suits, lead the king; but if it passes, do not pursue the lead, as certain the ace is in your partner's hand, as it is often kept up, but change your lead, and wait for the return from your partner when you have the finesse of the ten, if necessary.

King, queen, and five others, in all suits, the king. With four or less in trumps, lead the lowest. In other suits, always the king, unless you have the two only remaining trumps, if so you may play a small one.

King, knave, ten, &c. in all suits, lead the ten. King, knave, and two or more small ones, the lowest.

You should not lead from king, knave, and a small one, unless it is clearly your partner's suit, in which cases play off your king and knave.

Queen, knave, nine, and others, lead the queen. Queen, knave, with one other, the queen. Queen, knave, with two more, the lowest. Queen, ten, and two others, the lowest. Queen, and three small ones, the lowest. Queen, or knave, with only two, the queen, or knave.

The trump card sometimes occasions a deviation from these rules. A has the ace or king, with sequence from the ten downwards, of the suit of which his left-hand adversary turns up knave, or queen; A should lead the ten. If the knave or queen be put on, you have a finesse on the return with the nine; if not, your partner, with an honour, will pass it, and it is either way advantageous.

That which is denominated under-play, is returning the lowest of your left-hand adversary's lead, though you have the highest in your hand, with a view of your partner's making the third beat, if he has it, and still retaining the commanding card in your hand.

To explain this further, suppose A fourth player, has ace and king of his left-hand adversary's lead; to under-play, he wins the trick with the ace, and returns the small one, which will generally succeeded, if the leader has not the second and third in his own hand. You will see by this, if you lead from a king, &c. and your right-hand adversary, after winning with a ten or knave, return it, you have no chance to make your king, but by putting it on.

The following is another situation to under-play; A remains with the first, third, and fourth cards of a suit, of which he has reason to suppose his left-hand adversary has the second guarded; by playing the fourth, it is often paffed, and A makes every trick in the suit.

When it is at your option to be 8 or 9, it is material always to choose the former score. When at eight, with two honours, look at your adversary's score, and consider if there is a probability they should have their lurch, or win the game, notwithstanding your partner holds a third honour; if not you should not call, as it gives a decided advantage against you in playing for tricks.

Laws of Whist. - 1. If a card is turned up in dealing, the adverfe party on naming it may call a new deal, unless they have looked at, or touched the cards, fo as to have occasioned it; but if any card except the last is faced, it is undoubtedly a new deal.

2. Should any card-player have but twelve cards, and the others their proper number, the deal is good, and he who has the twelve cards pays for any renounce he may have
WHIST.

have made; but if either have fourteen cards, the deal is lost.

3. If the dealer does not turn up the last card, the deal is lost. But if the card is shewn, and falls on its face by accident afterwards, the deal in this case shall stand good.

4. The dealer should leave the last card on the table till he has played; after which nobody can ask for it, though they may inquire what is trumps at any time. Should he leave it on the table after the first round, it may be called, as if thrown by accident.

5. Every person has a right before he plays to call on the players to place their cards before them, which is, in other words, to ask who played them. It is therefore a quibble to say they have no right to make that demand.

6. The partner who reminds his partner to call after the trump is turned up, forfeits a point.

7. If one of the players omit playing to a trick, and remains with a card too many, it is at the option of the adversaries to call a new deal.

8. If A plays out of his turn to his partner's lead, the last player may play before the first: if to his adversary's, his partner may be compelled to, or prevented from winning the trick at their option.

9. Mistakes relative to tricks may be rectified at any time during the game, whether called or not. Also honours, if proved to have been called in time, though not scored; but they cannot be claimed after the trump is turned up.

10. If one party calls at any score but eight, the adversaries may, after consulting, call a new deal: the same, if one calls without two, or the other answers without one honour.

11. If any player calls after he has played, the adversaries may call a new deal; but not consult together.

12. Whoever calls, having only one honour in his hand, should forfeit in proportion to any advantage that actually does or may possibly accrue from the fault. If it should prevent the adversaries from calling, after the hand is played out, the honours shall take place of the tricks.

13. If any person plays out of his turn, the adversaries have the option to call that card at any time, or direct the player whose turn it was, to play any suit they choose.

14. If A, supposing that he has won a trick, leads again before his partner has played to it, the adversaries may oblige his partner to win it, if he can.

15. Any player may call a card from his adversary, if he names it, and proves the separation. Should he name a wrong one, he may have his best or worst card called of any suit played during the deal.

16. Cards thrown down cannot be taken up again; but may be called by the adversaries. They may be thrown down by the player, if sure of every trick.

17. There are in fact four penalties on a revoke, which take place of every other score. The adversaries may take three tricks from the party revoking, or three from their score, or add three to their own; and if there still should remain enough to make the party revoking game, they cannot win it, but remain at nine.

There is often judgment required in taking the penalties of a revoke. Before the score is advanced, if the party revoking has won nine tricks, the least consideration will shew, that the adversaries should take three of them, for if they add three to their own score, they still leave the odd trick to the former; but if the revoking party be at eight, it is better for the adversary to score three points, as the odd trick leaves the former at nine, which is in every respect a worse point than eight. On other occasions, it is only to calculate how the different scores will remain after each mode of taking the penalty; and it will be obvious which will be the most advantageous—never losing sight of the points of the game; i.e. scoring eight or five yourself, or prevent your adversary from doing so.

18. A revoke is not established before the party revoking has played again, or the trick been turned and quitted; but the adversaries, at their option, may call from the highest or lowest of the suit at the time, or the card shewn at any time during the deal.

19. If a revoke is claimed, the adversaries forfeit the penalties of a revoke, if they mix the cards before it is determined.

20. No revoke can be claimed after the cards are cut for the next deal.

21. A cafe having occurred in which A played out of his turn, and B, his partner, was directed to play a trump; but B had another suit, and three or four cards were played before it was discovered that B had a trump in his hand: it was decided, that the cards should be taken up again, and a trump led by B as directed.

22. A cafe occurred in which A called at eight, but his partner did not answer, though he had an honour, because he had a bet on the odd trick. The adversaries contended that the deal should not stand; and reference being made to Mr. M., he decided that the game was fairly won, because there could be no possible advantage made of the circumstance as far as related to the game, though it might as to the trick, if that had been the case referred; and their cafe produced the following law: viz. No one is obliged to answer to his partner's call, even though he has the other two honours in his hand.

23. No player, having three honours in his hand, can be precluded from taking advantage of them at any time previous to his playing a card. This law was grounded on the following cafe; viz. A at the score of eight, on gradually opening his hand, few two honours in it immediately, and told his partner of it, who did not answer: but A continuing to look over his cards found a third honour, and threw them down. It was contended that he had no right to do this, as Mr. M. thought improperly, upon which he proposed the above-mentioned law. We here subjoin a maxim connected with this cafe.

When at eight, with two honours, look at your adversary's score, and consider if there is a probability they should have their lunch, or win the game, notwithstanding your partner holds a third honour; if not you should not call, as it gives a decided advantage against you in playing for tricks.

24. Whoever shall by word or gesture manifestly dis- cover his approval or disapprobation of his partner's mode of play, or ask any questions but such as are specifically allowed by the existing laws of whiff, the adversary shall either add a point to his own score, or deduct one from the party to whom the question was addressed, at his option.

25. It is now settled, that either of the players may insist on the cards being placed at any time previous to their being put together. It is also settled, that where a bet is made, that either of the parties scores two, the bet is won by honour, though the adversary has won the game by cards—supposing it better that A makes two points, if B, his
his adversary, being at seven, makes three by cards, if A has
two by honours, he still wins his bet.
The odds of this game are calculated according to the
points, and with the deal, in the following manner:

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Except that 9 is considered as something worse than 8.
It is to 1 in favour of the first game. The odd trick has
been always supposed in favour of the leader; but Mr. M.
is of opinion, that this is an error, as the dealer has the advan-
tage in this, as in every other score.

We shall here subjoin an explanation of two terms that
are universally used, but not generally understood, viz.
tenance and finesse.

"The principle of the tenance is simple. If A has the ace
and queen of a suit, and B, his adversary, has the king and
knave, the least consideration will show that if A leads, B
wins a trick, and vice versa; of course; in every situation it is
the mutual plan of players by leading a losing card to put
it into the adversary’s hand to oblige him to lead that suit,
whereby you prefer the tenace. So far is easily comprehended;
but it requires attention with practice to apply the principle,
so obvious in the superior, to the inferior cards, or
fee that the same tenance operates occasionally with the seven
and five, as the ace and queen, and is productive of the same
advantage. A, last player, remains with the ace and queen
of a suit not played, the last trump, and a losing card: B,
his left-hand adversary, leads a forcing card. Query—How
is A to play?—Answer—If three tricks win the game, or
any particular point, he is not to ruff, but throw away his
losing card, because his left-hand adversary being then
obliged to lead to his suit, he remains tenace, and must make
his ace and queen. But upon a supposition that making
the five tricks gains him the rubber, he should then take
the force, as in these situations you are justified in giving up
the tenace for an equal chance of making any material
point.

"The finesse has a near affinity to the tenace, except that
the latter is equally the object where two, and the former
only where there are four players. A has the ace and queen
of a suit led by his partner, now the dulleft beginner will
see it proper to put on the queen; and this is called finesse
making, and the intention is obviously to prevent the king from
making, if in the hand of his right-hand adversary. Should
it not be there, it is evident you neither gain nor lose by
making the finesse; but few players carry this idea down to
the inferior cards, or see that a trick might be made by a
judicious finesse, against an eight, as a king; but to know
exactly when this should be done, requires more skill than
in the more obvious cases, united with memory and obser-
vation. Another case of finesse even against two cards
frequently occurs, and the reason on reflection is self-
evident.

"A leads the ten of a suit, of which his partner has the ace,
knave, and a small one; B should finesse or let the ten pass,
even though he knows the king or queen are in his left-hand
adversary’s hand, because he prefers the tenace and prob-
ably makes two tricks; whereas, had he put on his ace, he
could make but one—in short, tenace is the game of po-
tition, and finesse, the art of placing yourself in the most
advantageous one.” Matthew’s Advice, &c. ed. 10. 1816.

M. de Moivre has solved this problem: To find the odds
that any two of the partners, that are pitched upon, have
not the four honours? M. de Moivre concludes from this
solution

Vol. XXXVIII.

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<th>Chances of the Dealer</th>
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| to have besides the Card | Gameller to have pre-
| turned up. | cify. |
| 3910797436 | 0 | 81224544 |
| 2011672528 | I | 49034795232 |
| 4195196136 | II | 11061968904 |
| 4662159040 | III | 13896387120 |
| 3045452596 | IV | 1048979904 |
| 1218702014 | V | 4872688416 |
| 3014666962 | VI | 1421193788 |
| 4559999445 | VII | 258397416 |

Tab. I. 40714245 | VIII | 284999715 Tab. II. |
| 2010580 | IX | 18095220 |
| 48906 | X | 603174 |
| 468 | XI | 8892 |
| 1 | XII | 39 |

\[ \text{Sum = 158753389000} \]

is the common de-
nominator; being
the combinations of
12 cards in 51.

\[ \frac{476260169700}{15875} = \text{sum} \]

is the common de-
nominator; being
the combinations of
13 in 51.

By the help of these tables several useful questions may be
resolved; as, 1. If it is asked, what is the proba-
bility that the dealer has precisely III trump, besides the
trump card? The answer, by Table I., is \( \frac{4662}{15875} \); and the
probability of his having some other number of trumps is
\( \frac{3}{11213} \).
But if the question had been, what is the probability that some other gamester, the eldest hand for instance, has precisely IV trumps? The answer, Table II., is 104898.

2. To find the chance of the dealer’s not having fewer than IV trumps: add his chances to take o, i, II, which are 39108, 201127, 419592; and their sum 659827 taken from the denominator $1587534$, and the remainder made its numerator, the probability of the dealer having IV or more trumps will be $\frac{659827}{1587534} = \frac{329}{563}$, a little above $\frac{7}{12}$. The wager, therefore, that the dealer has not IV trumps, is so far from equal, that whoever lays it throws away above $\frac{1}{5}$ of his stake.

But if the wager is that the dealer has not V trumps, then $466213$ (the chances of his having IIII besides the trump card) is to be added to the chance for o, I, II; which will make the chance of him who lays this wager to be exactly $\frac{317}{455}$; and that of his adversary $\frac{138}{455}$.

And hence, if wagers are laid that the dealer has not IV trumps, and has not V trumps, alternately; the advantage of him who lays in this manner will be nearly 11½ per cent. of his stakes.

3. To find the odds of laying that the eldest hand has at least III, and at least IV trumps, alternately; the numerator of the one expectation is (by Table II.) $3150119$, and of the other $17514720$, to the denominator $47626017$; whence the advantage of the bet will be $\frac{15}{514}$, or three per cent. nearly.

Again, if it is laid that the trumps in the dealer’s hand shall be either I, II, III, or VI; the disadvantage of this bet will be only $\frac{152.42}{322}$ or about $\frac{1}{3}$ per cent.

In like manner, the odds of any proposed bet of this kind may be computed: and from the numbers in the tables, and their combinations, different bets may be found which shall approach to the ratio of equality; or if they differ from it, other bets may be assigned, which, repeated a certain number of times, shall balance that difference.

4. And if the bet includes any other condition besides the number of trumps, such as the quality of one or more of them; then proper regard is to be had to that restriction.

Let the wager be that the eldest has IV trumps dealt him; and that two of them shall be the ace and king. The probability of his having IV trumps precisely is, by Table II., $\frac{104898}{476200}$; and the different fours in 12 cards are $\frac{12 \times 11}{1} \times \frac{10 \times 9}{3} \times \frac{8 \times 7}{4}$. But because 2 out of the 12 trumps are specified, all the combinations of 4 in 12 that are favourable to the wager, are reduced to the different two that are found in the remaining 10 cards, which are $\frac{10 \times 2}{3}$. And this number is to the former as $1$ to $11$. The probability, therefore, is reduced by this restriction to $\frac{11}{11}$ of what else it had been: that is, it is reduced from near $\frac{1}{5}$ to about $\frac{5}{52}$. De Moivre’s Doctrine of Chances, p. 172, &c. ed. 3d.

WHISTLE, Boatswain’s. See Call.

WHISTLE-Fish, a name given by the people of Cornwall to a species of gadus, with only two fins on the back, otherwise called mulftela fluviatels. See Gadus, and Mustela.

WHISTON, William, M.A. in Biography, an English divine and mathematician, was the son of the rector of Norton near Twycroft, in Leicestershire, and born in the year 1667. He finished his education as a fiater at Clarehall, Cambridge, applying with great diligence to the study of mathematics, and composing devout meditations corresponding to the early bent of his disposition. Having also received the degree of B.A. in 1690, and being elected fellow of his college, he took pupils; and in 1693 became M.A. and entered into holy orders. Soon afterwards he declined the office of tutor, and was appointed chaplain to Dr. More, bishop of Norwich. His acquaintance with sir Isaac Newton commenced in 1694, and produced a change in his philosophical system, from that of Des Cartes to that of Newton. On the principles of this philosophy, he published, in 1696, his "Theory of the Earth," which was refuted by Kell. Having been prelected by his patron, the bishop, to the living of Lowestoft in Suffolk, he resigned his chaplainship, and in order fully to discharge his religious duties procured the affiliation of a curate. Of his invincible and moral scrupulous integrity, he gave an early instance by refusing his vote to a person who solicited a fellowship of Clare-hall, and who had abandoned the bachelorian party with which he was connected, and which he apprehended to be the most powerful, and promised future futility; and giving this reason for his refusal: "Sir, you have conceived that you sacrifices your integrity to your preferment, and thereby have made it impossible for me to serve you." Being obliged to vacate his fellowship by marriage, sir Isaac Newton nominated him his deputy as professor of mathematics, allowing him all the profits of the office; and in 1703 he surrendered to him the professorship itself. Upon this accession, he resigned his living, settled at Cambridge, and was appointed by Dr. More, bishop of Ely, catechetical lecturer of St. Clement’s. Having already published "A Short View of the Chronology of the Old Testament, and the Harmony of the Four Evangelists," and "Jacquet’s Euclid," he presented to the public in 1706 his "Essay on the Revelation of St. John;" and in the following year he preached the Boyle’s lecture sermon on the subject of the Accomplishment of Scripture Prophecies. In the year 1706 he began to entertain doubts concerning the divinity of Christ, and in the prosecution of his inquiries he was led to adopt Arrian opinions, which were further confirmed by the perusal of the "Apostolical Constitutions," reckoned spurious by most writers, but pronounced by Whitton to be "the most sacred of the canonical books of the New Testament." In 1708 he offered an "Essay on the Apostolical Constitutions" to be printed at the University press, but it was rejected; however, in 1709, he published sermons and essays supporting these opinions. His invincible perseverance caused him to be deprived...
deprived of the catechetical lecture, and at the same time he declined receiving the salary which the bishop wished to continue. His situation at the University became very precarious, and in October 1710 he was expelled from it, in conformity to a statute against maintaining doctrines contrary to the established religion. In the following year he also lost his professorship; and having no further employment at Cambridge, he removed to London, and published an account of the proceedings against him, and also books in defence of his sentiments, which he retained without regarding any worldly considerations. His purpotes were fixed, and he declared to two friends, who wished him to pay some attention to his present welfare, "you may as well peruse the fun to come down from the firmament, as turn me from this my resolution." Hoadly and Clarke remonstrated; but all their pleas were unavailing. All his future prospects seemed now to depend on his knowledge of mathematics, and accordingly in 1710 he published his "Prælectiones Physicæ-Mathematicæ; five Philosophia Clarissimi Newtoni Mathematica illustrata." At this time Additon and Steele, and several other persons, exerted themselves in procuring a subscription to his astronomical lectures. But at the close of this year he published the "Historical Preface" to a proposed work on Primitive Christianity, which subjected him to the iniquitous animadversion of the lower house of convocation. Escaping, however, the apprehended consequences of their interference, he persisted in his course, and in 1711 printed this work which he had announced, and which had occasioned an alarm, in 4 vols. 8vo. The convocation, not sufficiently informed with regard to the extent of their power in cafes of heresy, addressed the queen in order to obtain the opinion of the judges, who disagreed upon the subject, and no further measures were pursued by this body. However, in 1713, Whitton was prosecuted in the spiritual court; and as he did not appear to its citation, he was declared contumacious. Difficulties occurring on the part of the lay-judges, the business was deferred, and the prosecution was terminated by an act of grace in 1715. Whitton was at this time a professed member of the established church, and attended its worship, till at length he was refused admission to the sacrament; and therefore he opened an asylum for worship at his own house, and used a liturgy of his own composing. He also established a weekly meeting for the promotion of primitive Christianity, which subsisted for two years. Whitton was thus occasionally engaged, he devoted himself to mathematical and philosophical pursuits; and in concert with Mr. Ditton, who was his colleague in his lectures, published a project for discovering the longitude at sea. But as their speculations were of no use, it will be sufficient to observe, that he published at last a method of ascertaining the longitude by observations of the eclipses of Jupiter's satellites, with tables of such eclipses for four years from the year 1738.

His zeal in religious diffusions and projects remained unabated; and, among other publications in 1716 and the two following years, appeared several pieces founded on the suppositions of gnomonists and authority of the apologetic confutation. In 1719 he published a letter addressed to Finch, earl of Nottingham, on the "Eternity of the Son of God and his Holy Spirit," which received an answer from his lordship, that induced the clergy and universities to return him public thanks, and which caused Whitton's exclusion from the Royal Society, when he was proposed as a candidate in 1720. Sir Isaac Newton, it is said, who was of a very timid temper, took measures for defeating his election. As he was of opinion that the Jews would be speedily restored to their native land, he procured models of the tabernacle of Moses and the temple of Jerusalem, upon which he read public lectures. In 1741 he undertook a survey of the coasts of England, in order to fix the longitude of places, and a chart to this purpose was published in 1745. It was in the year 1747 that he discontinued his attendance on the service of the church of England, and joined a Baptist church, in which connection he continued. In 1749 he published two volumes of memoirs of his own life, to which a third was added in 1750. Having attained to the 87th year of his age, he died at London in 1752, and was interred at Lyndon, where his daughter was married, and where a handsome tomb was erected in honour of his memory. "Fancy," says one of his biographers, "predominating over judgment, a warm head and honest heart, enthusiastic fervour, and disregard to common forms and worldly conceptions, were the leading features of his character." He never hesitated in giving his opinion to all persons on all subjects, freely and without discrimination. Being once asked, in the presence of Additon, Pope, Walton, Craggs, and others, "whether a secretary of state could be an honest man consistently with the duties of his situation?" He gave his opinion that it would be of advantage to such an officer to speak openly what he knew, and declare his intentions without disguise. Mr. Craggs replied, "It might answer for a fortnight, but no longer." "Did you never, Mr. Secretary," returned Whitton, "try it for a fortnight?" When queen Caroline, who honoured Whitton's integrity, and was fond of his conversation, desired him to acquaint her what was particularly found fault with by censurers on her conduct; he replied, that her habit of talking at chapel was mentioned with disapprobation. She promised amendment, and wished him to point out any other faults. "When your majesty," said he, "has amended this, I will tell you of the next." A catalogue is given of Whitton's writings, which are very numerous, at the close of his "Memoirs of Dr. Clarke." He has also given a valuable "English Translation of Josephus," with plans, notes, and illustrations, to which are prefixed eight dissertations. Biog. Brit. Memoirs of his Own Life.

WHITAKER, John, B.D. a divine of the established church, was born at Manchester, about the year 1735, and educated at Oxford, where he became fellow of Corpus-Chrilli college, taking the degree of M.A. in 1759, and of B.D. in 1757. His first work, viz. "The History of Manchester," appeared in 1771, 4to, in which he takes occasion to give a view of the state of the kingdom in general. This work, abounding in literary research and ingenious conjecture, gave reputation to the writer, and was followed in the same year by "The Genuine History of the Britons asserted." However, it is said that Mr. Whitaker's imagination in the progress of his years milled his judgment, of which he gave evidence in the second volume of his "History of Manchester," printed in 1775, though he still maintained his character for deep and learned investigation. As a clergyman, he became morning-preacher of Berkeley chapel, London, in 1773, from which situation he was soon after removed; and he resented his removal with the natural warmth of his temper. Such was his orthodoxy, that he declined accepting a valuable living that was offered to him by an Unitarian patron. In 1778 he succeeded, as fellow of his college, to the rectory of Ruan-Lanyhorse in Cornwall, where his conduct about titles was the occasion of much uneasiness to him. When mutual conciliation took place between him and his parishioners, he published in 1783 a course of Sermons on Death, Judgment, Heaven,
and Hell, which were rendered peculiarly impressive by the fervid eloquence with which he treated the subjéct, naturally awful and interesting. In 1787 he published his "Mary Queen of Scots vindicated," 3 vols. 8vo., in which he fur-
poffed former writers in the zeal with which he vindicated this unfortunate queen, and criminated her enemies, Eliza-
beth, Cecil, Morton, and Murray. He also prefented to the public the fruit of his learned research in "The Course of Hannibal over the Alps ascertained," 2 vols. 8vo. 1794; and in 1795 he advanced the highest monarchical principles in his work, entitled "The real Origin of Government," and also his orthodoxy in his "Origin of Arianism," zealously defending his sentiments in both these refpects by contributions to the English and Jacobin Reviews, and British Critic. At length a paralytic stroke warned him of his approaching end, and after a gradual decline he im-
perceptibly closed life at his rectory in October 1808, at the age of 73, leaving a widow and two daughters. Gen.
Biog.

WHITBREAD, Samuel, an eminent brewer, claims
a place in a work devoted to the record and promotion
of the arts and sciences, on account of the talents which
he displayed and the character which he maintained in his
advancement from small beginnings, to the possession of a
fortune, that set him on a level with some of the first no-
bility of the country. The family from which he sprang
belonged to the class of yeomanry, in the county of Bed-
ford, which possessed some small property, and associated
with that description of moderate dillenents, who occasionally
conformed to the Church of England. Born in the village
of Cardington near Bedford, about the year 1720, and edu-
cated probably with a view to trade, for which his family
designned him, he was bound apprentice at a suitable age, for
the term of seven years, to an opulent brewer in London;
and after the expiration of that period, he remained for
some time unsettled, as he was cautious in commencing bu-
nifies on his own account. At length, however, actuated by
the laudable ambition of tracing the footsteps of those
who, in a similar department, had risen to opulence and
rank, he determined to make trial for himself, how far in-
dustry and activity, aided by economy, would avail to his
success. Having disposed of his own patrimony, which
could not have been very considerable, and deriving affilia-
tion from persons of opulence, who were encouraged to re-
pose confidence in him by his known disposition and habits,
he laid the foundation of a superstructure of fortune and
reputation, which has had few parallels in the history of
commerce. Simple in his manners, he was accustomed to
appear at the corn-market in Mark-lane with a white apron,
as the emblem of his occupation; and liberal in his dispo-
sition, he contrived to secure the attachment and active ser-
\n\sices of those with whom he was connected in his domestic
\arrangements, and in the conduct of his business. He well
\knew that by making those whom he employed partakers
\of his bounty, he gave them a kind of interest in his pro-
\sperity; and therefore on settling the annual balance of his
\accounts, he distributed amongst them donations, correspond-
\ing to their respective ranks and services. Whilft he gave
\50l. to a confidential clerk, he extended his bounty even
to the horfe-feeders, to each of whom he usually gave 5l.

Advancing with sure, but rapid progress, his brew-house
in Chiswell-street became a famous quadrangle, confliting
of an ample dwelling-house, work-houses, stoves, cellars,
and every other kind of convenience both for habitation and
business; while the flock, the plant, the dry-horses that
would have mounted a regiment of cavalry, the eafks, &c.
might in process of time be estimated at nearly half a mil-
lion of pounds sterling. To this immense property, we
might add a floating capital amounting to from 8c to
100,000l. serving to supply the demand of malt, hops, oats,
&c. as well as the payment of clerks and servants. Thus
the direction and superintendence of a single individual,
with the co-operation of a number of coadjutors in various
ranks of subordination, the brew-house in Chiswell-street
became the first establishment of the kind, not only in Lon-
don, but in Europe, depending for its subfinence and fngu-
lar prosperity on the approved quality of the article which
it furnished. To the founder and principal proprietor, it
became a mine of wealth, and an immense feece of supply
for purchases of land and houses, donations and bequests,
which have given distinguished celebrity to the name of Whit-
bread. It is needless to recount the various eftates which
he purchased in his native county; we shall content our-
\selves with mentioning merely the Torrington manors and
eftates, for which he paid the sum of 120,000l., besides
5000l. as a preffent to alderman Skinner the auctioneer,
when the negotiation respecting it was completed. Of
his benefactions and bequests to various objects of public
utility and of private charity, it will be sufficient to say,
that they indicated the liberality of his disposition, and the am-
\plitude of the means which he derived from his fngular
prosperity. Mr. Whitbread was twice married; by his firft
wife he had feveral children; but his fcond wife, who was
d Hust of the firft earl, and fifter of the firit marquis
Carroll's, and to whom he was married August 12,
1769, died December 27, 1770. He was for fome years
one of the repreffatives of the town of Bedford, and
afterwards returned for the borough of St.eyning. For
the abolition of the slave-trade, he was a ready and ardent
advocate; and as fuch he generously undertook from his
private purse to make good all injuries that might be suf-
\fered by thofe who attended to give their testimony for this
purpofe. With this expression of benevolence he clofed a
life, during the progress of which he had amassed landed
and chattel property to an immense amount, without any of
thofe penurious habits, which have been in many inftances
the means of accumulating large fortunes, and of enablin-
gh to die rich who have lived meanly and miserably. His
death happened June 11th, 1796.

In 1799 his fon, the fubject of the next article, erected
a splendif monument to his firft wife, and born in the year
1758. Deflined to the inheritance of a large fortune, and
possifiting talents which by due cultivation would qualify
him for a conspicuous fation in public life, his father spared
no expece in his education. At a proper age he was fent to
Eton, where he also enjoyed the benefit of private tuition,
and where he commenced an intimate acquaintance with
Mr. W. H. Lambton, afterwards M.P. for the city of
Durham, and Mr. now earl Grey, with whose family he
became connected by a double alliance. From Eton he
removed to Chriftchurcb college, Oxford, and from thence
to St. John's college, Cambridge, where he finiflied his ed-
ication, and was graduated B.A. Mr. Whitbread ferior,
fagacious in difcerning the early dawnings of his fon's future
celebrity, liberally offered him all the advantages which might
be
be derived from foreign travel, and selected for his tutor and companion the present archdeacon Coxe, well known by a variety of valuable publications. Having travelled together through France, Germany, and Switzerland, they afterwards separated with professions of mutual regard. Mr. Whitbread, soon after his return, formed, in 1788, a matrimonial connection with Miss Grey, the sister of his Eton associate, who afterwards, by the advancement of her father, general Sir Charles Grey, to an earldom, became lady Elizabeth Whitbread: his sister also, in process of time, married the present sir George Grey, bart., then a captain in the navy. Having acquired every necessary qualification for occupying a seat in the great council of the nation, and interested by an ample fortune either in possession or in prospect, as well as by genuine sentiments of patriotism, in its deliberations and resolutions, Mr. Whitbread offered himself, on the dissolution of parliament in 1790, as a candidate for Bedford, a borough which had been represented by his father, who at the same time offered himself for the borough of Steyning. Both elections were contested; but both father and son finally obtained their respective seats. Mr. Whitbread, junior, commenced his political career in parliament with an animated speech against the unconstitutional doctrine of "confidence," assumed on the part of ministers, who claimed an entire reliance on their wisdom and integrity. The occasion of this claim was a proposed war against Russia, for which the minister (Mr. Pitt) urged the house of commons to vote money, without previous and satisfactory information of the necessity, and much less of the justice or policy of this war, the object of which was the reformation of Oczakow to the Turks. The measure was unpopular; and though the minister obtained a majority, when the question was debated, he thought it most prudent to give up his object, and a pacification ensued, which prevented much calamity to the nation. About this time the abolition of the slave-trade occupied the public attention, and this was a measure to which the member for Bedford had always avowed himself a steady and zealous friend. In parliament he supported it not only by his vote, but by a display of eloquence which commanded universal applause. As an active magistrate, he directed his particular attention to the occurrences that took place in consequence of the scarcity in the year 1795; and in devising means of relief, he proposed that the magistrates were empowered to fix a maximum of wages, so far as respects the husbandman, a minimum should be also preserved by law, in order thus to establish a more accurate proportion between the price of labour and that of the means of subsistence. With this view he introduced into the house a bill, which was approved by Mr. Fox and many other members; but as it was opposed by Mr. Pitt, his efforts were unavailing. The minister was no less unsuccessful in his plan for amending the poor laws, and mitigating the condition of the pauperism and working class. His plan indeed was much more extensive and complicated than that of Mr. Whitbread, which was simply calculated to enable the labourer to maintain himself by his wages, without the degrading as well as dispiriting necessity of seeking parochial relief.

The subject of this article was an undignified and uniform oppressor of the French war in 1793, because he thought it to be unnecessary and unjust; and yet he was a zealous advocate for measures of self-defence against the secret machinations and open attacks of a powerful and vindictive enemy. Accordingly he condemned the negligence of ministers, on occasion of the French attempt at invasion in 1797, by means of a squadron which appeared off Bantry bay, and moved the house for a committee of inquiry into their conduct. His motion was evaded by the previous question. In every stage of the contest with France, and under every varying form of its government, he was anxious for peace, and an advocate for treating with its rulers in order to terminate hostilities, and to put an end to the waste of national treasure and the effusion of human blood. His opinion on the conduct of ministers in the prosecution of this war, and their reluctance to enter into treaty for terminating it, was explicitly avowed in an eloquent speech, which he delivered on occasion of a motion by Mr. Dundas (then secretary of state) for an address to the throne in 1800, for the purpose of approving the conduct of his majesty's government. Anxious, however, as he was for peace, because he disapproved the war from its commencement, and because he thought it essential to the true interest of the country, he was no less solicitous to maintain the honour of the nation in obtaining it. No man in this respect was a more noble-minded patriot than himself; and if he ventured to make any sacrifice, it was because he thought it absolutely necessary to the permanent prosperity of his native country. Whilst he claimed and exercised the privilege of pronouncing his own opinion of public men and political measures, he was a zealous advocate for the liberty of others, and interposed with his most vigorous exertions for the release of those who suffered imprisonment at home or exile to Botany bay, for too freely and imprudently divulging their opinions. During the short interval of the administration of Mr. Addington, (the present lord Sidmouth,) who succeeded Mr. Pitt in the year 1801, and made peace with Buonaparte, several popular measures were adopted, in which Mr. Whitbread cordially concurred; and in the year 1805 he distinguished himself as the public accuser of Mr. Dundas (created lord Melville) for malversations that had occurred, whilst he had occupied the post of treasurer of the navy. His charges against this nobleman were founded on a report of the commissioners of public accounts, from which it appeared that, during the exercise of his office, this noble lord had violated the law, by conniving at mal-practices and participating in unwarrantable emoluments; and that he was responsible for deficiencies amounting to 697,500l. These charges also implicated Mr. Trotter, Wilton, and Spratt; and the former in particular, who was paymaster of the navy department under Lord Melville, and had taken out large sums of money on his own private account. In the investigation of this business, it was discovered, that the sums officially deposited in the Bank had been withdrawn, lodged with private bankers, and applied to other purposes besides those that were properly naval. Mr. Whitbread founded on several facts which he stated, a variety of resolutions which impeached the fidelity and honour of his lordship. To his motion relative to this business, Mr. Pitt moved an amendment, which was negatived by a majority of one (217 to 216), in consequence of the vote of the speaker. In consequence of these proceedings, the vicount resigned his office at the Admiralty-board, and his name was expunged from the list of privy-councillors. Upon the sudden demise of the premier, and a coalition between lord Grenville and Mr. Fox, the two latter came into office; and Mr. Erkine, being raised to the peerage, and appointed lord high chancellor, was deputed to preside at lord Melville's trial. This nobleman having made his defence within the bar of the house of commons was replied to by the member for Bedford; and an impeachment being agreed upon, proceedings commenced in Westminster-hall, April 29th, 1806. The result, after a short trial, was the acquittal of his lordship by a majority, from all the charges alleged against him. Notwithstanding the unexpected termination of this trial, neither the friends
friends nor the enemies of the supposed delinquent attached any blame to the public accuser; but he was allowed to have conducted the business assigned to him with a dignity and propriety suitable to its delicacy and importance. In the case of Lord Melville, as well as in that of Mr. Pitt, he knew how to distinguish between the man and the minister; and to pay a just tribute to the talents and dispositions of the former, whilst he criminated and condemned the latter. Having differed with Mr. Pitt with regard to his political measures almost through the whole of his public life, he took the opportunity which the trial of Lord Melville afforded him of paying a just tribute of respect to his abilities and virtues, when his premature death must have vindicated the eulogy from the slightest suspicion of infirmity and adulation.

Of the new administration, he was a steady supporter; but though he had at an early period enlisted himself under the banners of Mr. Fox, and the Earl Grey, his school-associate and brother-in-law, who was one of its distinguished members; he was their friend as ministers, not from personal and selfish motives, but from a conviction of his judgment that their principles and views were most favourable to the liberty and welfare of the British empire. Indeed he was regarded by many as an impracticable man, because in all great questions he was influenced by principle more than by any private and party attachment. What were his sentiments of the coalition ministry, and what were the grounds of the support which he afforded them, he had an opportunity of stating in the most explicit manner. At this time Sir Francis Burdett offered himself a candidate for the county of Middlesex, and transmitted a circular letter to Mr. W., who had voted for him twice before, soliciting his support. This letter contained reflections on the coalition ministry, which led the subject of this article to decline giving his vote for Sir Francis, and also to express his sentiments of the coalescing parties, which had been feverely cenured. "I have supported the present administration," says Mr. W., "from a conviction that they were united upon principles of real public utility, and for the purpose of carrying into execution plans of great national improvement, both in our foreign and domestic circumstances; and I cannot abandon them, because in a situation more difficult than that in which any of their predecessors have ever flourished, they have not been able to effect what I believe to have been nearest the hearts of them all—I mean a peace with France; seeing such a peace could not have been obtained on terms confident with national honour, and because time has not sufficed to mature and execute the schemes of internal improvement, which they have manifested their determination to pursue," &c. Having stated some other opinions with regard to the union of parties, in which he seems to have disagreed with Sir Francis, he concludes: "These radical differences render it impossible for me to assist you in becoming a member of parliament. Different opinions may be maintained conscientiously with mutual and entire personal respect; such as I unfeignedly profess towards you. The determination you have taken to avoid the expense of conveyance and decorations so conspicuous at your former elections, does you honour; and I with such an example could be followed by all other candidates," &c. The publication of this correspondence threatened a very undesirable termination; but it was happily prevented by the interposition of friends.

During this period, Mr. Whitbread took an active part in public affairs, and distinguished himself on a variety of occasions, guarding on the one hand with vigilant jealousy against an undue exertion of the royal prerogative, and on the other against its infringement by the democratical part of the constitution. In February 1807, he renewed his attention to the existing system of poor laws, as it was his wish and incessant endeavour to improve it, and in doing so to render the peasantry happier, better, and less dependent. It was also an object, which he conceived to be of essential importance, to controul the several branches of public expenditure, and thus to relieve the difficulties of the country. Much depended, he well knew, on peace with France, and to this deliberandum his views and efforts were constantly directed. But he was almost ready to despair of this desirable event, "from the awful moment that death closed the scene upon the enlightened statesman (Mr. Fox) who had first commenced the negociation." When the Grenville administration was obliged to retire, and a new parliament was convoked by its successors, he published a spirited address to his constituents, in which he stated the measures which had been projected and wholly completed or commenced during the existence of the late ministry, and the part which he had taken in the deliberations of the preceding parliament, closing with these memorable words: "I court your inquiry, and if you are satisfied in the result of it, I hope for your votes in the present election. If you do me the honour again to return me, I shall indeed be proud of it, and I will again endeavour to do my duty." The next important object of his attention was the education of the poor, as intimately connected with their morals and religion; but unable to obtain a legislative function to his plan, he was under a necessity of recurring to individual exertions and private subscription. During the important debates that occurred in 1809, with regard to the orders in council, he concurred with those who condemned this measure, and contributed first to their supfension, and at length to their utter discontinuance. With regard to the situation of Spain, he was one of those who conceived the conduct of the French government, and who wished the natives to be stimulated to new exertions in behalf of the independence of their native country. "In 1809," says one of his biographers, "he took an active part in the inquiry and examination into the conduct of the royal duke who preceded over the army, and although he found much to blame on that occasion, yet, at a future season, he feized the first opportunity to afford his testimony in behalf of his royal highness, whose administration as commander-in-chief had contributed not a little to the happy and glorious termination of the late contest. That event did not prevent him, however, after the overthrow of Buonaparte's government, from blaming the conduct of the Congress, and expounding the ambitious views of some of the sovereigns, particularly in respect to Saxony. On the return of the emperor from his exile in the isand of Elba, the member for Bedford (strongly and emphatically) censured the declaration of the allies, more especially that part of it which seemed to recommend the detestable principle of annihilation. He also loudly inferred both on the policy and injustice of a new war, on the ground that the executive power of the enemy was vested in the hands of any one particular person. But above all things he protested against the forcible restoration of the Bourbons by a foreign force, and the assumed right of dictating a government to France. Yet he most cordially joined in a vote of national gratitude to the duke of Wellington, for the memorable victory at Waterloo, although he at the same time boldly avowed that events had not altered his sentiments in respect to the pretended justice of the original contest."
WHITBREAD.

infruction of the poor, Mr. Whitbread was affidious and indefatigable; and whilst he was overwhelmed by a multiplicity of occupations, he voluntarily undertook a more Herculean labour than any other, which was the arrangement of the perplexed concerns of Drury-lane theatre. With every moment of his time thus occupied, and his mental powers unremittingly exerted, it is no wonder that his health should decline, and that his mind itself, though naturally vigorous and ardent, should be impaired by excess and intemperance of application. The consequence that might have been apprehended unhappily occurred, and the world was prematurely deprived of the benefit of his valuable services. "His countenance changed; he became droisy, lethargic, and irritable; and he even supposed himself to have fallen into contempt." These indications of corporeal and mental decay were alas! too soon succeeded by that fatal catastrophe, which occurred on Thursday, July 6, 1815.

"An inquest having been summoned by Mr. Gell, the coroner, at eight o'clock the same evening; at the house of the deceased, No. 35, Dover-street, Piccadilly, and having entered his study, he beheld Mr. Whitbread lying on his back, his arms and legs extended, with a deep incision on his throat from ear to ear, a small part in the front of the throat excepted. A looking-glass was opposite to him; his apparel and the floor were covered with blood; and the fatal razor was found at some distance!"

The verdict of the jury was as follows:—"That the deceased Samuel Whitbread, esq., died by his own hand; but that he was in a deranged state of mind at the time the fatal act was committed." His principles and character have been justly delineated by one of his biographers, and we shall briefly deline them as are consistent with our contracted limits. "In politics he was a Whig; yet a Whig of the old school; one who wished to balance the royal power, by means of a due influence of the popular branch; but at the same time firmly andfeelingly to uphold both. Accordingly, he was always a strenuous, consolant, and uniform advocate for a reform of the house of commons: but this great measure was grounded on the ancient and acknowledged bases, not on the visionary plans of annual parliaments and universal suffrage. As a patriot, he wished for the happiness and prosperity of his country; but these, he deemed most likely to be acquired, and most permanently enjoyed by cultivating the arts of peace, advancing the commerce, cherishing the manufactures, and encouraging the agriculture of his native land. Wars might indeed be popular, successful, glorious; but it was also incumbent and imperative that they should be both just and necessary. It was his firm opinion, that economy was to be as proper for a state as for a private family: he was always, therefore, a decided friend of order, regularity, and good management. He hated jobs; he viewed placemen, courtiers, and contractors, with a jealous eye; and he disliked both unnecessary and excessive pensions, not only on account of the sums thus perverted from the public revenue; but also from their obvious tendency to produce meaner, sycophancy, and dependance.

"Mr. Whitbread was a strenuous advocate for national education, or instruction on a great scale. But finding himself unable to obtain a national sanction to this measure, he contented himself with his assistance and support as a private individual.

"He was an encourager of the fine arts; and always de- flous that they should enjoy protection and applause."—"To agriculture, as a science calculated to advance the interests of the nation, he paid particular attention."—"Horticulture also engaged his notice, and the gardens, and lawns, and groves of Southwell, might have all been exhibited as so many perfect specimens of care, neatness, and propriety.

"Although always doubtful of the justice of the late war, he never hesitated for a single moment as to the propriety of arming and defending his native country against the menaces and attacks of her enemies. He himself raised and commanded a body of sturdy yeomanry; and while he thus excited a martial ardour in his neighbour, he forgot not to enforce his favourite plan of fitting men, by means of education, for their respective stations in life. On this occasion, he instituted a school for the benefit of the non-commissioned officers, and contributed by all the means in his power to render it effectual.

"An only son, born and matured with the expectations of great opulence; it is but little surprising if he occasionally displayed a certain degree of haughtiness in his demeanour. Indeed it cannot be denied, that at times he appeared somewhat haughty and overbearing; but on the other hand, he must be allowed to have been admirably fitted for command; and was seldom known to exceed the bounds of moderation, but when he combated the injustice of power, affixed the influence of office, or endeavoured to expel successful guilt to shame and to punishment.

"His heart constantly glowed with all the social affections. He was zealous in his friendships; while his enmities were transient and short-lived. His ear was ever ready to listen to the tale of the oppressed; his purse always open to succour those who had been reduced to distresses by unexpected calamities. At length, after having lived and acted during the stormy politics of the French revolutionary contest, he was suddenly cut off, at a period when his services might have proved highly advantageous to his country; when the deceitful calm of peace seemed imminent with greater and more formidable dangers than those arising out of a long, widespread, expensive, and destructive warfare!

"On the 11th July, 1815, when the marquis of Tavistock, on moving for a new writ for the borough of Bedford, decanted on the character, worth, and talents of the late member, his encomium was listened to amidst the loud cheers of both sides of the house of commons:

"Acquainted to defend his opinions with warmth and earnestness," said he, "the energies of his ample and comprehensive mind, would never permit the least approach to tameness or indolence. But no particle of animosity ever found a place in his breast, and he never carried his political enmities beyond the threshold of this house. It was his uniform practice to do justice to the motives of his political opponents; and I am happy to feel, that the same justice is done to his motives by them. To those who were more immediately acquainted with his exalted character; who knew the directness of his mind, his zeal for truth, his unshaken love of his country, the ardour and boldness of a disposition incapable of dismay, his unaffected humanity, and his other various and excellent qualities, his loss is irreparable. But most of all, will it be felt by the indigent in his neighbourhood. Truly might he be called the poor man's friend. Only those who, like myself, have had the opportunity of observing his conduct closely can be aware of his unabated zeal, in promoting the happiness of all around him. His eloquent appeals to the house in favour of the unfortunate, will adorn the pages of the future historian; while at the present moment, they afford a subject of melancholy retrospection to those who have formerly dwelt with delight on the benevolence of a heart that always beat, and on the vigour of an intellect which was always employed for the benefit of his fellow-creatures!"
He left behind him by lady Elizabeth, his mourning widow, two sons and two daughters.

The following memorandum of Mr. Whitbread's sudden death was written immediately after the lamentable event was ascertained, in the title-page of a very ancient edition of Cicero's "Paradoxos," by a friend who highly respected the stern virtues both of his public and his private character:

SAMUEL WHITBREAD, armiger:
Vir illusiris iube, quern omnes liberales brevi in tempore appellabant

ANGLICUM CATONEM,
E terra fuit eretus die sexto Julii, anno Chrall 1815.


WHITBY: DANIEL, a learned divine of the church of England, was born at Ruthden, in Northamptonshire, in 1638, and admitted to Trinity college, Oxford, in 1653, where he took the degree of M.A. in 1660, and became fellow of his college in 1662, in which year he first appeared as a writer against popery. In 1668 he was appointed chaplain to Dr. Seth Ward, bishop of Salisbury, and collated to a prebend in his church. In 1672 he took the degree of D.D., and about this time was made rector of St. Edmund's parish in Salisbury. From this time he became a considerable writer in the popish controversy, publishing "A Discourse concerning the Idolatry of the Church of Rome," 1674; "The Absurdity and Idolatry of Holt-Worship proved," 1679; "The Fidelity of the Roman Church demonstrated," 1687; and "A Treatise of Traditions," in two parts, 1689. He also expressed, in common with several other liberal persons at this period, his wishes for an union of all Protestants, in a piece published in 1683, and intitled "The Protestant Reconciler; humbly pleading for Condescension to Difsembling Brethren in Things indifferent and unnecessary, for the Sake of Peace, &c." This publication was too liberal for the times, and called forth a host of adversaries. But the most formidable attack was that of the famous Oxford decree, which passed a cenure on the following propositions contained in it: viz.

"It is not lawful for superiors to impose any thing in the worship of God that is not antecedently necessary:"—"The duty of not offending a weak brother is inconsistent with all human authority of making laws concerning indifferent things:" which propositions were denominated in the decree false, impious and seditious doctrines; and the book was burnt in the quadrangle of the university schools. But it was still more humiliating to the author to be required by his patron, the bishop, to declare his sorrow for having written the work, and to renounce by name the two preceding propositions. This conduct was very unworthy of a Christian bishop, and fixes a permanent stigma on the memory of Ward. It reminds us of the Inquisition and Galileo. (See Galileo.) Dr. Whitby, actuated probably by a desire to conciliate his adversaries, or urged to adopt this meaurence, published in the same year a second part of the book, in which he strongly protests the dissenting laity to join in full communion with the established church, and replies to all the objections of the Non-conformists against the lawfulness of their complying with its rites and ceremonies.

No man could more sincerely rejoice in the Revolution than Whitby, nor more cordially welcome the emancipation of British subjects from all kinds of tyranny. Accordingly he published two tracts in favour of the oath of allegiance required on the accession of king William; and in one of these tracts he maintains the principle in the English government of an original contract between the prince and the people.

His capital work, however, was the result of fifteen years' study, and is intitled "A Paraphrase and Commentary on the New Testament," 2 vols. fol. printed in 1703, several times reprinted, and held in high estimation by biblical students. To the edition of 1710 he annexed a Latin appendix, containing an examination of Dr. Mill's various readings, under an apprehension that they might prove injurious to the authority of Scripture. This great work of Dr. Whitby was followed by several tracts on theological subjects, in which he seems to value himself on that freedom of discussion which, with new times, he was allowed to indulge, more especially as he occasionally strays beyond the fixed boundaries of what has been called orthodoxy. Among these tracts were, "The Necessity and Usefulness of the Christian Revelation;" "A Discourse concerning the True Import of the Words Election and Reprobation;" "The Extent of Christ's Redemption;" "The Grace of God;" "The Liberty of the Will;" "The Perseverance or Defeatibility of the Saints;" "Four Discourses on Election and Reprobation;" "A Treatise on Original Sin," in Latin, in which he denies that the imputation of Adam's sin to his posterity has any fair ground in Scripture. Upon the publication of Dr. Clarke's "Scripture Doctrine of the Trinity," Dr. Whitby adopted his opinion, and wrote a Latin treatise, intended to prove that the controversy respecting the Trinity could not with certainty be determined from fathers, councils, or Catholic tradition. In connection with this subject of controversy, he published "A Discourse from Inquiry into the Doctrine of the Trinity; or, the Difficulties and Discouragements which attend the Study of that Doctrine." In the Bangorian controversy, he was one of the auxiliaries of Dr. Hoadly, and printed several tracts. He also published several sermons. But his last work, which did not appear till after his death, was "The last Thoughts of Dr. Whitby, containing his Corrections of several Passages in his Commentary on the New Testament; to which are added Five Discourses; published by his express Order." In the preface to this work, written at the close of a long life of learned and laborious inquiry, the author says, "when he wrote his Commentaries, he went on too hastily in the common beaten road of other reputed orthodox divines; conceiving first, that the Father, Son, and Holy Ghost, in one complex notion, were one and the same God, by virtue of the same individual essence communicated from the Father; which confused notion (he adds) he is now fully convinced to be a thing impossible, and full of gross absurdities." A short illness closed the life of this eminent biblical scholar, on March 24, 1725-6, at the age of 88. He is represented by a biographer as a man of great simplicity of character, singularly ignorant of worldly affairs, entirely devoted to his studies, but affable, pious, and charitable. He preferred a tenacious memory to the laity, but through a defect of sight was obliged to employ an amanuensis. Biog. Brit.

WHITBY, in Geography, is a considerable sea-port town of the North-Riding of Yorkshire, England, situated between Flamborough-head and the entrance of the river Tees. Considering the ruins of the ancient abbey as the principal object of the town, the latitude of Whitby is 54° 29' 24" N., and the longitude o° 35' 59' W., from the meridian of Greenwich. It is 47 miles N.E. of York, and
WHITBY.

The town is placed at the mouth of the small river Elk, which divides it into two unequal parts. The direction of the river, running nearly due north towards the sea, determines that of the town, which extends along its banks. These banks rise almost suddenly from the river on both sides; particularly on the east, so as to leave but a very narrow stretch of level ground at the bottom, of which, indeed, a great part has, at different times, been gained from the bed of the river. This narrow space is literally covered with houses; but the town ascends the steep banks on both sides, and thus presents a romantic appearance, especially when viewed from the sea; the whole surmounted by the old weather-beaten church, on the verge of the eastern cliff, and the venerable remains of the abbey behind. The eastern half of the town extends about three-quarters of a mile; but the breadth where greatest does not exceed 150 yards. The western division is the largest, the most compact, and the most elegant. Although now of importance, Whitby was but inconsiderable in trade and population, until towards the beginning of the last century. Its origin may, however, be carried back to the foundation of the celebrated monastery in the seventh century. That the Romans, or the original Britons, had any establishment at Whitby, we have no grounds to affirm; although the opening of the river into the sea must have afforded a convenient station for sailing and navigation; of which, had the Romans been a commercial people, they would doubtless have availed themselves, especially on a tract of coast so little furnished with harbours adapted to their shipping. On this part of the coast may, perhaps, be placed the bay mentioned by Ptolemy, under the romanized name Dumum Sinus, of which the most commodious inlet was the mouth of the river, now, by a peculiar appropriation of a generic British name for water, called the Elk. After the establishment of the monastery of St. Hilda in the seventh century, the vicinity began to be inhabited. Under her successor Ætheldea, daughter of Osywy, the port had some share of shipping; for, in 684, the abbess took a voyage, with some monks of the abbey, to the isle of Coquet, on the coast of modern Northumberland, to have an interview with St. Cuthbert. Suffering and again restored with the abbey, after the devastation by the Danes in 867, Whitby obtained its present name, signifying the White town. It was also from the monastery occasionally called Preiftby, or Priesttown. Although unmentioned in Dome-day-book, Whitby, prior to 1189, had become of such importance, that the abbot erected it into a borough, with the customary privileges. Thence privileges were soon after confirmed by a royal charter; and had no unfair means been employed to let them aside, Whitby might now have been a royal borough. But the liberties of Whitby were of short duration: the monks repented of their liberality to the town, and Peter, the succeeding abbot, in 1200, procured from king John a repeal of the charter of his predecessor. About the year 1538, Whitby is described by Leland as a "great fisher town," and nothing more is added by Camden, who mentions the place fifty years later. For many years after the dissolution of the abbey, the vessels of the port were few and small; and the trade was inconsiderable until the establishment of the alum-works at Guisborough, at the close of Elizabeth's reign. A spirit of emulation being excited by the success of these works, a similar establishment was formed in 1615 at Sand's end, within three miles of the town. The vicinity of Whitby abounding with the alum-mineral, other undertakings of the same kind were begun. Hence two important branches of industry were formed in the town; the one to supply the alum-works with coal, the other to export the alum to dilant parts. From these beginnings, the trade of Whitby increased; the schemes of the inhabitants were enlarged; the number of shipping was augmented; and new ships were constructed, for which timber was drawn from the oak-woods of the vicinity. In this manner, the trade and navigation of the town grew up to such a height, that, in the beginning of the present century, Whitby was the seventh in rank for tonnage among the ports of England. In 1816, the number of vessels belonging to the town was 285, carrying 46,341 tons, and navigated by 2674 seamen. Besides the carrying of coal, with the alum trade, and a share of foreign commerce, the number of vessels fitted out from Whitby for the Greenland whale-fithery, begun in 1755, was, in 1800, next to that of those failing from London. As early as the middle of the 16th century, small wooden piers were constructed at the mouth of the Elk, for the protection of the fishing-craft: but in 1632 these piers were begun, through the exertions of Sir Hugh Cholmeley, who, by the favour of the earl of Strafford, his relation, obtained a general contribution over England in aid of the work, when nearly 500 were collected. The navigation of Whitby becoming of importance, acts of parliament were obtained, in 1702 and 1723, for constructing a pier, which now extends above two hundred yards from the cliff on the east side of the harbour, westward to the channel of the Elk. By this work, security was obtained for the town as well as the shipping, both of which were greatly exposed to north-easterly winds. Another pier, on the west side, was afterwards added, running out about an equal distance towards the sea. By subsequent additions and improvements, the harbour has been essentially benefitted. The west pier, now carried out to the length of three hundred and forty yards, is constructed with large blocks of squared stone, and terminates in a circular head, with embrasures for a battery. Within the piers, vessels to the number of five hundred may lie, but all on the ground at low water. The harbour is divided into the outer and the inner by a drawbridge, so constructed as to allow ships of two hundred tons to pass through. In the latter, which is capacious and secure, on both sides of the river are constructed several dry docks, and other accommodations for ship-building. The vessels built for the coal-trade are particularly valued for their strength and durability. One built in 1724 was lost on the Lincolnshire coast in 1810, but did not go to pieces; another, wrecked a few years ago, was above one hundred years old. In neap-tides the water rises from ten to twelve feet at the entrance of the harbour; but in ordinary spring-tides the depth extends from fifteen to eighteen feet. In the equinoctial gales, the depth of water is sometimes increased to twenty-three or twenty-four feet. The trade of the port of Whitby is but small in proportion to its shipping, as many of the largest vessels are employed in time of war as transports, and at other times by the merchants of London, and of other ports. The trade of the town is, however, considerable for its situation, in a country abounding with moors, where few manufactures are carried on. The alum-works in the environs are of great antiquity, and may not improbably be carried back to the Roman times. But the first work established in Britain, in later times, was begun by Sir Thomas Chaloner in 1595, on his eftate at Belman-rock, near Guisborough, twenty miles to the westward of Whitby. Since that period, alum-mineral has been extracted in various other places, particularly at Sand's end, three miles well from Whitby, where the work is still in a prosperous state. Until the year 1789, the alkaline lyes employed

Vol. XXXVIII.
employed in the manufacture were prepared from kelp, or
sea-weed, burnt on the shore: but since that period kelp
has been gradually superceded by black-ashes, made from
the refuse of soap-boilers’ lees. The average annual quan-
tity of alum manufactured in the Whitby district, for the
last twelve years, was 28,400 tons; but in 1816 the quan-
tity was 31,550 tons. Little alum is now exported, nearly
the whole being sent to London. The number of persons, 
including artificers and boys, belonging to the works, is
about 600. (See Alum.) Thin seams of coal have, for
upwards of seventy years, been wrought in the environs of
Whitby, but of a very inferior quality, and used only in
the interior parts of the country.

Whitby contains no public building of note. The town-
hall, erected by the late Mr. Cholmley, is a heavy pile of
the Tuscan order. The poor-house, extensive, and judi-
ciously managed, affords a comfortable refuge for the dif-
tressed, and tends to diminish the heavy burden of the
parish-rates. A dispensary, liberally supported, for distri-
buting advice and medicines to the poor, was established
in 1780. The parish-church stands near the top of a hill,
on the east side of the town, a little to the northward of
the ruins of the abbey, accessible from the bottom by an
inconvenient ascent of 190 stone steps. The architecture
of the edifice is originally what is absurdly styled Gothic;
but it has gone through so many alterations, that little of
its ancient appearance now remains. The church-yard is
exceedingly crowded with grave-stones; but the sea-air of
Whitby is so destructive of stones, that inscriptions are
soon effaced. For the use of the numerous inhabitants,
the spacious chapel of ease has been erected in the lower
depart of the town; and for the country part of the parish,
which is of great extent, three others have been built. 

That at Sleights, four miles from the town, is a handsome edifice. Roman Catholics, Quakers, and various other classes of differents, have their respective places of worship in the town. According to the parliamentary returns of 1811, the houses of this town were 1395, and the inhabitants 6969: but in the spring of 1816, the population was found, by a careful inquiry, to have increased to 10,203.

The inhabitants of the country part of the parish were then estimated at 1477 persons.

The town of Whitby is close, irregular, and unpleasant; but the environs are romantic and beautiful. These are embelished with the country-residences of the opulent in-
habitants, mostly erected on commanding situations: the
most interesting object of all, however, is the celebrated
Abbey, of great antiquity, having been originally founded
in the year 655. Before the fanguinary but decisive battle
of Leeds, on the banks of the Oore, in which he utterly
overthrew and slew his invader foe, Penda, king of the
Mercians, Owfy, king of the Northumbrians, vowed, if
successful, to erect and endow a monastery, and to confe-
crate to the service of religion in it his daughter Ælleda,
then scarcely a year old. In discharge of this engagement,
he founded the monastery of Streonehall, of the Benedictine
order; with this peculiarity, that it was to contain
both monks and nuns, all under the government of St.
Hilda, the first abbess. It is, nevertheless, probable, that
the introduction of the monks, by which the institution
became in all respects similar to that of the celebrated abbey
of Fontevrand, in the well of France, did not take place
till several years after its establishment. The monastery
was begun in 657, and dedicated to St. Peter; but fish
was the veneration entertained for St. Hilda, that it was
always called by her name, and to her was the foundation
ufually ascribed. While Hilda was abbess, the fynod of

Whitby was held in 664, in which, notwithstanding her
opposition, strengthened by that of Colman, the festival of
Easter was directed to be celebrated at the time adopted by
the sovereign pontiff, instead of that which had been in
general observance in Britain. Dying in 682, Hilda’s place
as abbess was filled by Oswy’s daughter, Ælleda. Till
the year 867, the abbey continued to prosper; but it was
then overthrown by the sons of Lodbrog the Dane. In
this state it remained until after the Norman Conquest; the
lands in the neighbourhood were granted to Hugh, the first
earl of Chester, from whom they passed to William de
Percy, ancestor of the Percys of Northumberland. By him
the monastery was restored from its ruins under a prior;
but in the reign of Henry I. it was again raised to the rank
of an abbey. Although pillaged by a Norwegian fleet in
the time of abbot Richard, who died in 1175, its revenues
at the dissolution, under Henry VIII., amounted to 525l.
s. t. a. At this epoch, the seque and lands, partly by grant
and partly by purchase, became the property of Sir Richard
Cholmley, a descendant of the family of Cholmondeley, in
Cheshire.

Of Whitby-abbey, the ruins of the church alone remain;
but by these, which are still considerable and grandly
picturesque, it appears that there have been a magnificent
structure. The exterior length of the church, which is built in
the usual form of a cross, is 310 feet; the breadth at the west
end, including the transepts, is 60 feet by 145 feet by the
length of the nave, 1153 feet. The church probably occupies the site of the Saxon building erected before the Conquest; but of it,
not even the edifice constructed immediately after the
re-erection of the monastery, no vestige now remains. The pres-
ent structure is of different ages, and exhibits different
styles of architecture. The eastern part, or choir, evidently
the oldest, was probably built by Richard de Burgh, who was
abbot from 1148 to 1175, and who rebuilt the chapter-house.
The lower part of the tower, and most of the pillars, which are all clustered, were perhaps erected at the same time: but the north transept and the upper part
of the tower are of a later date. The ornaments of the
windows in those parts, the beautiful range of niches on the
walls within, the tracery of the circular window in the north
end, &c., seem to indicate the work of the clothe of the 13th
or the beginning of the 14th century. The west front is the
latest part of the whole, probably of the time of Edward III.,
or in the end of the 14th century.

The alum-works in the vicinity of Whitby are not less
curious than valuable, from the variety of petrified sub-
stances they contain. Besides the usual petrifications of
shells and other marine bodies, parts of the human skeleton
have been occasionally discovered. In the early part of
the last century, Dr. Woodward, the celebrated naturalist,
dug up on the foar, or cliff, on the east side of the harbour,
the petrified arm and hand of a man, having all the bones
and joints very visible. About 1743 was found, in the alun-
rock, the complete skeleton of a man; but it was broken
by pieces by taking from the bed. A similar discovery is
said to have been made about nine years ago; but the
skeleton was broken without any scientific person having
examined it. In 1758, the bones of a crocodile, as they
were imagined to be, were drawn from the rock, and tran-
ferred to the Royal Society, by Mr. Home, according
them to be published in the 53rd volume of the Philosophical
Transactions. About four years afterwards, the skeleton
of a horse was found in the alun-works at Saltwick, thirty
yards under the surface. Ammonites, or cornua-ammonis,
vulgarly called snake-stones, abound, with other teftaceous
petrifications, in the aluminous schistus in the vicinity of
Whitby;
About nine miles to the northward of Whitchurch is Hawkstone-park, long the residence of the ancient family of the Hills, and a place celebrated for its natural and artificial beauties and curiosities. The mansion, an elegant modern building situated on the north side of a romantic hill, is adorned with a lofty portico of the Composite order. With the beauty of the exterior of the edifice, the interior fully corresponds: the chapel and the faloon are particularly elegant, and the latter is ornamented with valuable paintings. The grounds around the mansion are particularly interesting for their assemblage of naturally romantic scenes, to which art has greatly contributed. The grotto, the view from the cliff, called Poali's-point, the retreat, or hermitage, St. Francis's cave, the Swifs bridge, the terrace, the obelisk, and the widely-extended prospect it presents over the surrounding country, the tower, the artificial river, the cottage, or whim, are among the many attractive features of Hawkstone-park, which owes much of its embellishment to the taste and munificence of the late Sir Richard Hill, bart. The beautiful and romantic scenery of this noble place is fully detailed in T. Roden hurl's "Description of Hawkstone."


WHITCHURCH, a small but ancient borough and market-town in the upper half hundred of Evingar, Kingsclere division of Hampshire, Englad, is situated on the borders of Chute Forest, at the distance of 13 miles N. from Winchester, 24 miles N. by E. from Southampton, and 57 miles W.S.W. from London. It poifeles the rights of a borough by prescription; and has sent two members to parliament since the twenty-seventh year of queen Elizabeth. The borough is the joint property of lord Sidney and lord Middleton; the freeholders, which give the right of voting, being conveyed by them to their respective friends for the purpose of performing the ceremony of an election. The freeholders are nominally about seventy, but the real electors are said to be appointed and influenced by the noblemen before-mentioned. The government of the town is vested in a mayor, annually chosen at the court-leet of the dean and chapter of Winchester, to whom the manor belongs. The town, though small, is remarkable for a variety of religious fefts: there being, besides the church, places of worship for the Independents, Anabaptists, Quakers, Methodists, and Sandemanians. A market is held weekly on Friday, and three fairs annually. The population of the parish, as ascertained by the return of the year 1811, was 1407; the number of houses 281: the labouring classes are chiefly employed in woollen manufactures, and in agriculture.

Adjoining to the western end of Whitchurch is one of the entrances to the earl of Portsmouth's distinguished residence, Hurstbourne-park. Of late years the park has been much enlarged. The grounds contain considerable diversity of surface and scenery; and the conversion of a small stream into a broad piece of water, has tended very much to improve the place. In the old part of the park, trees have attained a size much beyond what might be expected from the chalk and flint which constitute a great portion of the soil of North Hampshire. An old manion-house flood in the bottom near the present parish-church and village: but the late lord Portsmouth pulled it down and erected the present building in a much more eligible and healthy situation. It stands on elevated ground, commanding extended and varied prospects, particularly to the south and the north. This manion, erected by Mr. Meadows from the designs of James Wyatt, eqq. consists of a centre and two correspondent wings connected to it by colonnades. The eastern wing contains the library and a chapel, and in the

Whitby; on which account, probably, the town has chosen three amonites for its arms. "Robin-Hood's Bay," six miles south-east from Whitby, is a noted fishing-lation, frequented for protection by many a vessel palling along that extended tract of inhospitable shore. Among the country-feasts in the vicinity of Whitby, which are not numerous, is Mulgrave castle, the mansion of the earl of Mulgrave, situated five miles westward from the town, on a lofty eminence, commanding a most extensive prospect both by land and sea. Near to the southward stand the remains of the ancient baronial castle of Mulgrave. Manifest evidences of Roman occupation are to be seen in various parts of the surrounding country. The Roman road from Eboracum (York), northwards by the vicinity of New Malton, (perhaps the Derwentine of Antonine,) and apparently terminating at Durnley, near the sea, three miles W. from Whitby, is in many places very perceptible. Along its course still remain traces of Roman encampments, of which the camps at Caulthorpe, 10 miles S.W. from Whitby, supposed to be the Dolgoitia of Antonine, are very perfect. These works are noticed in general Roy's "Military Antiquities of the Romans in Britain," but much more particularly in "The History of Whitby and Streonshahall-abbey, with a Statistical Survey of the Vicinity," by the Rev. George Young, in 2 vols. 8vo. Whitby, 1817.

WHITCHURCH, a populous market-town in the north part of the hundred of North Bradford, and county of Salop, England, at the northern extremity of the country, is situated 20 miles N. by E. from Shrewsbury, and 160 miles N.W. by N. from London. The church, the chief object of notice, seated on the top of the hill over the town, is a spacious modern structure, erected in 1722, with a square tower 108 feet in height. Two recumbent stone figures are preserved from the ruins of the old church; of which one represents the celebrated John Talbot, the first earl of Shrewsbury, and marshal of the realm of France in the reign of Henry VI.: he was called the English Achilles, and was greatly renowned in the wars of France. Shakespeare, in his play of Henry VI., describes Talbot as a most formidable and magnificent character: "the terror of the French,—the scare-crow that affrights their children:—whole grizzly countenance made others fly,—none durst come near him for fear of sudden death." Another effigy represents Christopher Talbot, fourth son of John Talbot, second earl of Shrewsbury, and who was rector of Whitchurch and archdeacon of Chester. The rectorcy of this parish is one of the richest in the county. The cattle has long been in ruins. Whitchurch has a very respectable free-school, in which many persons of eminence have been educated. Here are also meeting-houses for Protestant dissenters, a charity-school for children of both sexes, and six alm-houses for aged women, endowed by Mr. Samuel Higgenson. A weekly market is held on Friday; and here are two annual fairs. The town is a place of much public resort during the horse-races which are occasionally held here. Among the natives of Whitchurch, was distinguished the celebrated linguist Abraham Wheelock, who translated the New Testament into Piscium, and affixed Dr. Brian Walton in the compilation of his polyglot Bible. Wheelock published also an edition of the writings of the venerable Bede. He died in 1654. The population return of the year 1811 states the town of Whitchurch to contain 552 houses, and 2580 inhabitants: but the parish comprehends besides the town, thirteen townships. The whole population is returned as 5532; the number of houses as 1107.

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the western are apartments for servants. In the library were preserved a considerable body of the MSS. on various matters, philosophical and theological, of the illustrious Newton. They came into the possession of this family in consequence of the marriage of John, vicount Lymington, (son of the first earl of Portland) in 1745, with Catharine Conduit, great niece and coheir of Sir Isaac. Those papers were examined by the late learned bishop (then doctor) Horley, while preparing his edition of Newton's works. See Newton, Sir Isaac.

A little to the eastward of Whitchurch, near the London road, is Freefolk, noted for the paper-mills belonging to John Portal Bridges, esq., where the paper for the notes of the bank of England has been manufactured ever since the reign of George I. At Laverstoke is the seat of William Portal, esq.; and in the adjoining parish of Overton is a handsome new house, the seat of — Jarvis, esq. In the village a silk-mill has been established. In various spots at no great distance from Whitchurch, are still visible evidences of Roman occupation. The great sows-way, a Roman road leading from Sorbiodunum, or Old Sarum, to Vindonum, or Silchester, passes across the downs two miles to the northward of the town. Near the course of this way, at Egbury, a Roman encampment, forming an irregular quadrangle, may be easily traced, the rampart in most parts is still lofty; the longest side measures about 300 yards. On several eminences within the extent of a few miles from Whitchurch are circular or ring-polls, commonly called beacons; but evidently military stations of the ancient inhabitants of the country, to which they could resort, and on which they could secure their families and property, in the event of hostile affault from domestic or foreign foes. — Beauties of England and Wales, vol. vi. Hampshire; by J. Britton, F.S.A. and E.W. Brayley.

WHITE, GILBERT, M.A. in Biography, an agreeable writer of natural history, was born at Selborne in Hampshire in 1720, and completed his education at Oriel college, Oxford, of which he was elected fellow in 1744. In 1746 he took the degree of M.A., and in 1752 became one of the senior professors of the University. Unambitious in his temper, and fond of rural scenery, he fixed his residence in his native village, and devoted his time to literary pursuits, and particularly to the investigation of those subjects of natural history, which furnished him with lessons of piety and benevolence. The refolt of his observations was communicated to the public in his "Natural History and Antiquities of Selborne," 1789, 4to. the first and principal part of which consisted of letters addressed to Mr. Pennant, and affords a variety of remarks, chiefly in the zoological departments, peculiarly amusing and no less instructive: and the second part treats of the antiquities of the place. Highly esteemed by all who knew him, he died in 1793; but after his decease, the natural history of his work was published separately in 2 vols., 8vo. 1802, with the addition of miscellaneous observations, and a Naturalist's Calendar, extracted from his papers, and of paralleled remarks communicated by W. Markwick, esq., an accurate observer of nature in the county of Suffolk. Gen. Biog.

WHITE, JOSEPH, Regius professor of Hebrew, and Laudian professor of Arabic, in the university of Oxford, was born in Gloucestershire in 1746, and being of humble origin, but devoted to reading whilst he was pursuing his father's occupation as a weaver, attracted the notice of a neighbouring gentleman, who sent him to Wadham college, Oxford. Having graduated M.A. in 1773, and chosen fellow of his college, he directed the main bent of his studies to the oriental languages, under the advice of Dr. Moore, afterwards archbishop of Canterbury. Such was his proficiency in this department of literature, that in 1775 he was elected Laudian professor of Arabic, on which occasion he delivered and printed an oration on the utility of that language in theological studies. By the recommendation of bishop Lowth, he was appointed editor of the Philoxenia Syriac version of the four gospels, which he published in 1778. About this time he was nominated one of the king's preachers at Whitehall; and in a sermon preached before the university of Oxford, he recommended a revision of the English translation of the Old Testament. In 1780 he published a "Specimen of the Civil and Military Institutes of Timour," transliterated from a Persian version of the Mogul original, written by the conqueror himself. He also added a specimen of Persian poetry, and recommended the study of this language. The Institutes having been translated entire by major Davy, were published from the Clarendon press in 1783, under the inspection of professor White, who annexed a preface, indexes, and geographical notes.

As Bampton lecturer, to which office he was appointed in 1781, he preached a course of sermons before the university, which were printed in 1784, and much admired for their learning and eloquence. The general design of these sermons was to evince the excellence of the Christian religion, on a comparison with that of Mahomet. (See Ar. Coran.) It was discovered, however, somewhat to the disgrace of the professor, that he had derived very considerable afurance in the composition of these sermons from the masterly pen of Mr. Badcock, who had been a diffenting minister at South Molton, and afterwards conformed to the church, and that several of them were actually written by him. It was also known, that Dr. Parr, from his ample store of Greek literature, had furnished the materials that had been wrought up into two of these sermons. These facts were investigated and ascertained; and the charge against the professor was sufficiently substantiated, and it was founded, not so much on his want of ability for such productions, as on his impiety, and on certain habits unfavourable to study. His reputation, however, as a defender of Christianity was acknowledged, and he was presented to a prebend of Gloucester, and soon after was graduated D.D. About the year 1790 he married, and accepted a college-living in Suffolk. In this situation he prosecuted his studies, and having set up a press in his house, and furnished himself with oriental types, he and his wife performed the business of compositors, and a man and maid-laborant of that press. Hence originated his "Egyptiaca," relating to the antiquities of Egypt; and an edition, with a version, of an account of that country by an Arabian writer named Abdallah. In 1799 Dr. White published from the Clarendon press his "Diatararion," or the harmony of the four evangelists, in Greek, a work useful to biblical students. He died in 1814, at the age of 68. Gen. Biog.

WHITE, one of the colours of natural bodies. White is not so properly said to be any one colour, as a composition of all the colours; it being demonstrated by sir Isaac Newton, that those bodies only appear white, which reflect all the kinds of coloured rays alike, and that the light of the sun is only white, because it consists of all colours.

From the multitude of rings of colours, which appear upon comprising two prisms, or object-glasses of telescopes together, it is manifest, that these do interfere and mingle with one another at last, as after eight or nine refractions, to dilute one another wholly, and constitute an even and uniform whiteness: whence, as well as from other experiments,
it appears that whiteness is certainly a mixture of all colours; and that the light which conveys it to the eye is a mixture of rays endowed with all those colours.

The same author fliws, that whiteness, if it be most strong and luminous, is to be reckoned of the first order of colours; but if fliws, as a mixture of the colours of several orders: of the former fort, he reckons white metals; and of the latter, the whitenefs of froth, paper, linen, and most other white substances. And as the white of the fliw order is the strongest that can be made by plates of transparent substances, so it ought to be stronger in the denser substances of metals, than in the rarer ones of air, water, and glass.

Gold or copper mixed either by fusion or amalgamation with a very little mercury, with silver, tin, or regulies of antimony, become white; which fliws, both that the particles of white metals have much more surface, and therefore are smaller than those of gold or copper; and also, that they are too opake, as not to suffer the particles of gold or copper to shine through them. And as that author doubts not, but that the colours of gold and copper are of the second or third order, therefore the particles of white metals cannot be much bigger than is requisite to make them reflect the white of the fliw order. See Colour, and Colours from Metals.

Hevelius affirms it as a thing most certain, that, in the northern countries, animals, as hare, foxes, bears, &c. become white in the winter time; and in summer refume their natural colours.

Black bodies are found to take heat sooner than white ones; by reason the former absorb or imbibe rays of all kinds and colours, and the latter reflect all.

Thus, black paper is fooner put into a flame, by a burning glass, than white; and hence black cloths, hung up by the dyers in the fun, dry sooner than white ones. See Black.

White of the Eye, denotes the fliw tunic or coat of the eye, called albuginea and conjunctiva, because it serves to bind together or inclose the refl. See Adnata, and Eye.

White Ale, in Rural Economy, a liquor of the malt kind, which is faid to be prepared somewhat in the following manner. Twenty gallons of malt are mashed with the fame quantity of boiling water; when after flanding the ufual time, the wort is drawn off, and fix eggs, four pounds of flour, a quarter of a pound of salt, and a quart of grout, are well beaten up together, and mixed with the above quantity of wort, which, after flanding twelve hours, is put into a cask, and is ready for ufe the day afterwards.

It is obferved by the writer of the Devonshire Corrected Report on Agriculture, who has supplied the above account, that this liquor is almost exclusively confined to the neighbourhood of Kingfoife, in that county; and that it is a beverage which poifesfes a very intoxicating quality, and which is much admired by those who drink not merely to quench thirst. A mystery, it is faid, hangs over the ingredient called grout, and the secret is faid to be confined to one family in the above district only. No difficulty, however, it is fuppofed, could arife in ascertaining its component parts, by submitting a certain portion of it to the fett of chemical examination. It is plain, it is faid, that this liquor is of confiderable antiquity, from the terrifer of the adwofon of Dobbrook, which expressly calls for the title of white ale.

This mild pleasant liquor may easily be made in other places.

White Antimony Ore, in Mineralogy, Antimoine Oxide, Hauy, generally occurs dillemated and crystallized in veins along with other ores of antimony on primitive rocks. See Antimony.

White Arsenic, and After. See the Sublimatives.

White Bait, in Ichthyology. See Clupea.

White Beam. See Crataegus.

White Bear. See Polar Bear.

White Bear, the Anar Hypeborea. See Duck.

White Bug, in Gardening, an insect of the bug kind, which is often very troublesome and hurtful in vinery, peach-houses, and other such forts of houses for fruit-trees.

It is obferved in the first volume of the Memoirs of the Caledonian Horticultural Society, that the caufe of this insect fo frequently making its appearance in these houses, is much owing to the neglect in not washing the trees properly every day with the engine in many cases. That when a vinery is much overrun with it, in order to its removal, all the old bark should be fript from off the vines, and all the shoots and treills be properly fponged over with black soap and warm water. The writer always makes it a rule, at the time of the winter-pruning, to take off the outer bark, whether infested with them or not, as these bugs lodge between the old and new bark. That in regard to peach-trees, which are infested in this way with the white bug, they should be sponged all over in the fame manner in the winter season; and if any bugs should appear in the spring, it is a good way, it is faid, to tie pieces of mat round the limbs and large branches of the trees; as about these parts these insects take shelter from the heat of the sun. Once every day these portions of mat should be taken off, and thrown away out of the houses. That soon after forcing is begun, the female of these bugs will be observed to be much larger than the male. At which time the infamity goes into some hollow of the trees or bark, and deposits her ova or eggs mothly in some fountains. These are easily capable of being discovered, and may be picked out of such hollows or crevices by means of a large pin, or small piece of sharpened stick; which is an effectual way of getting quit of them, and of preventing their future增进. See Washing Fruit-Trees.

White Campton, in Agriculture, a pernicious perennial weed in corn lands, pastures, and hedges, which is often difficult to destroy, except by good fummer tillage of the ground. See Weed, and Weeding.

White Caterpillar, or Bore, in Gardening, a very destructive fort of insect of this kind, but which is not fo numerous as those of the other kinds, nor does it attack and destroy the fame parts of gooseberry-bulhes, though equally injurious on others. It is of comparatively a fmall size too, in relation to those of the other forts, the black and green, that infest these bulhes; the former of which, the large or black, may be observed, it is flaid in a paper in the Horticultural Transacttions of Scotland, lying during the winter months in large clufers on the under parts, and in the crevices of the bulhes of these forts; and that even in the month of February they have been found in that flaie. But that in the course of eight or ten days after that, if the weather be favourable, they will creep up the bulhes in the day-time, feed on the young buds, and return to their nest during the night. That whenever leaves appear upon the bulhes, they feed upon them until they arrive at maturity, which is generally about the month of June; after which they creep down upon the under sides of the branches, where they lodge until the crust or shell is formed over them. That in July they become moths, and lay their ova or eggs on the under sides of the leaves and of the bark. That the produce
produce of these ova or eggs, which come into life during the month of September, feed on the leaves so long as they continue green, and afterwards collect and gather together in clusters on the under sides of the branches, and in the cracks and openings of the bark, where they abide all the winter, as has been already seen. Consequently that winter is the most proper time for attacking and destroying this sort of these infects with success, as their destruction is then most effectually and completely accomplished by merely the simple operation of sprinkling and pouring a quantity of boiling hot water over and upon them, from a watering-pan or pot, by which no injury, it is said, will thereby be done to the bushes or gooseberry fruit-turfs.

That the latter or green fort are in the shell state in February, when they lie about an inch under the ground. That in the following month they come out small flies, and immediately lay their ova or eggs on the veins and under sides of the leaves. That these ova or eggs produce young caterpillars in the month of May, which feed on the leaves of the bushes until June or the succeeding month, when they crawl off blackish kind of skin, and afterwards crawl down from the bushes into the earth, where a sort of crust or shell grows over them, and in that state they continue until the following April.

The only method which this writer has hitherto found effectual in destroying this sort of these gooseberry-caterpillars, is first to dig the ground all around the bushes very deep during the winter season, by which means the greater part of them are either destroyed, or buried too deep ever to rise to the surface: or, fecondly, in the month of April, when the flies make their appearance, to pick off all the leaves on which any ova or eggs are to be discovered, which is a tedious operation, but may be performed by children. If any of the infects should escape both these operations, they will, it is said, be discernible as soon as they come into life, by their eating holes through the leaves, and may then be easily destroyed, without the least injury to the bushes or fruit.

That this white kind bores the berry, and causes it to drop off from the bush. That they preserve themselves during the winter season in the chrysalis state, about an inch under ground, and become flies nearly at the same time with the latter of the above kinds. That they lay their ova or eggs on the blossoms, and that these eggs produce young caterpillars in May, which feed on the berries until they are fully grown, and then creep down into the earth, where they remain for the winter in the shell state.

This fort of these caterpillars, too, may be best destroyed in the winter season, by having the land well and deeply dug all about the gooseberry bushes at that time of the year, and by preventing them from climbing up the stems of the plants in the early spring season, for the purpose of laying their eggs, by every possible means that can be devised and referred to by the gardener.

These are the best and most effectual methods that have yet been discovered by this writer, for the destruction of this and the other two sorts of gooseberry-caterpillars. For though many other modes of doing it have been tried, none have been found so certain and complete as these; and they have this advantage and consideration to recommend them, that they injure neither the bush nor the fruit. That the same thing cannot be said either of tobacco-liquor, snuff, or soap-fluxes, all which render the fruit constantly bitter and ill-tasted; and which, whatever may be the effect that they may have upon the smaller kind of caterpillars, it is certain, the writer thinks, that they have none upon the larger kinds, and that fruit, lime, and lime-water, do not affect any fort

of caterpillar whatever, as the writer has sufficiently proved by repeated experiments with such substances.

White Ceylon Tea, in Agriculture, an annual weed in woods and other such places; of which animals in general are not fond. It is said to form the balls of the famous Portland powder for the gout. See Weed.

White Cinnamon. See Cinnamon.

White Clover, in Agriculture, a well-known plant of the clover kind, which is perennial, and consequently lasts a number of years in the soil or land. It is said to require a deep free foil to bring it to any degree of luxuriant growth. Consequently but little of the land in many districts suits it; but it is sometimes found with the common clover in about half the quantity. In the Berkshire Report on Agriculture, it is stated, that it is frequently confounded with the Dutch clover, that it affects a light foil, that it is much improved by rolling, and that it yields a very sweet hay when mixed with red clover, rye-grass, and nonfuch. That heep are not very fond of it; and this is, probably, one reason why it is not cultivated than it deserves to be. It appears, it is said, to be the Irish shamrock; and that the powdered flowers of this clover being made into bread, were eaten by the natives of the little island before the introduction of potatoes. It may be noticed, too, that it is capable of bearing flooding, which the red clover is not, and this is a very great advantage in its favour.

It is remarked also, that the real Dutch clover is not unfrequently sown with other granules, in a larger or smaller proportion, as the farmer may think proper. That in some places of the above county it is the common practice to sow of broad clover eight pounds, yellow trefoil, or hop clover, four pounds, and of Dutch or white clover, two pounds, to the acre. If it be sown alone, about eight or nine pounds will be sufficient. It is getting into high estimation in the neighbourhood of Bray, in the above district, and in other places, and is sometimes called honey-fuckle grass, from the sweetness of its smell. That to all sorts of cattle it forms an agreeable pasture, and especially to heep, which thrive on it prodigiously. Even swine will fatten on this grass, the feed of which was imported from Flanders for some time after it began to be cultivated this country, though it appears to be an indigenous plant. It has the excellent property of never wearing out by being close fed. See Tripoli, and Hyb. All CLOVER:

White clover is said, in the Gloucestershire Agricultural Report, to be injurious to cow-rock, by boving them when in abundance after rain in pastures.

White Colours, in Painting, comprehend the following; viz. FLARE White, White-Lead, or Cerussa, calcined or burnt Hars-Horn, the perfection of which depends upon its whitest aff and firmness, distinguishes both by sight and touch, Pearl-White, Troy-White, and Egg-Shell White. (See the several articles.) The most delicate and perfect white in use, in its application to the purposes of painting in water-colours, is the artificial sulphate of barytes. According to Mr. Parker (Ell. vol. ii.), it was first recommended and brought forward by Mr. Hume, of Long-Acre, who has long supplied the public with it under the name of "Permanent White." The same ingenious practical chemist says, that he knows of nothing so well calculated as this for marking bottles in a chemical laboratory, where the gages soon destroy the ink of common labels, and render them illegible. It is equally useful for marking jars, bottles, or boxes, which must be kept in a damp cellar, for it is not only imperishable in such situations, but preserves its extreme whiteness, and consequently the distinctness of the characters. We learn also from Sir Humphrey Davy's
Many’s “Elements of Chemical Philosophy,” that the combination of barytes and carbonic acid, made artificially by pouring a solution of carbonic acid into a solution of nitrate of barytes, forms also a pigment of a very white colour.

**White Colours, in Dyeing. See Colour.**

**White Copper Ores, in Mineralogy.** One of the rarest ores of copper, and has frequently been confounded with copper pyrites, and other ores of that metal. (See Copper Ores.) Its colour is between silver-white and bronze-yellow; it occurs massive and disseminated; it has a metallic lustre. The fracture is fine-grained and uneven; it yields easily to the knife. The specific gravity of this ore is 4.5. It contains about 40 per cent. of copper mixed with iron, arsenic, and sulphur.

**White Copperas, Cordage, Eagle, and Egg-Shell. See the sublimate.**

**White Cofa-Lettuce for Hogs, in Agriculture.** The use of it in feeding these animals. A trial of it in this way is flated to have been made in Sussex, which is particularly deserving of attention: the weaning of young pigs, without much milk and none corn, is often a difficult business; but if this sort of lettuce will do it, which seems to be the case, no farmer should ever be without a stock, or half an acre of this sort of crop for this use.

In this trial, four ounces of this sort of lettuce-seed were sown very thick over two parishes of ground in the beginning of March. A crop of potatoes was in rows at three feet distance; between which a double row of these lettuces was planted in May; both crops being afterwards kept clean by hand-hoeing. In the June following, they were begun to be used for three fows with little pigs, which were kept on these lettuces for six weeks; but these fows had wath in addition: the pigs were then weaned a fortnight earlier than usual; and after the weaning, the great use of the lettuces was found, for the pigs did admirably well upon them, until they all were gone in the middle of August. They were then fed as usual, with cabbage, turnip-tops, and other such vegetable matters, but fell off at once for want of the lettuces. See Lactuca, and Lettuce.

**White Crops, a term applied to all sorts of grain-crops, as wheat, rye, barley, oats, and some others, in contradistinction to those of the green and culmiferous kinds, such as cabbages, turnips, rape, tares, beans, and some others of a similar nature.**

**White Darnel, a very troublesome and prolific weed among corn-crops, especially of the wheat kind. See Weed, &c.**

**White Enamel. See Enamel, and Enamelling.**

**White Face, or Blazes, in the Manes.** A white mark upon a horse, descending from the forehead almost to the nose. It is called in French *chanfre blanc.*

**White Film, or Blindnefs, a difeafe in sheep, which is occasioned by a white film growing over their eyes, in conformance of some sort of inflammation, as arising from different causes, taking place in them.**

The appearances by which it is shown to be present are, according to some, that the animal cannot bear the light, that the white part of the eye is red and inflamed, and that it waters a great deal. That this state is succeeded by a sort of membrane or coat formed by the inflamed veffels, which first covers the white, but gradually extends over the eye, until total blindness is the confequence. That this is noticed to be the cafe, when in folding, the sheep run against dykes, or any other fuch obfacles, and flart when they approach them; that they do not follow the flock, and that they frequently tumble. That when the eye is infpefted, it is generally found, that a blue fliough covers the whole of the eye, without any intermixture of red veffels. That in the worst cafes, the coloured and transparent part of the eye becomes of a reddish-white; by which time, the film on the eye has acquired confiderable thicknefs and hardnefs. That the inflammation is produced in various ways, and by various means; as during the summer feaon by the reflection of heat and light in very funny and dry weather, as it is found to be more frequent when the hilly sheep-walks become fioreched, and on hard rocky fiols, than on the dark-coloured hills which are covered with heather. Others fuppofe, that the difeafe is sometimes caufed by the pollen or dust of flowers irritating the eyes of the sheep, when blown into them, in confiderable quantities, by the wind. That in the winter, the blindnefs is caufed and occurs when the days are very funny, and the evenings frotly and cold; or when the sheep have been long buried under snow, and the ground is still white and glaring when they get out.

But by other others, the blindnefs in sheep is believed to arise from a caufe wholly different from any of these. That it is induced by a continued fatigue for a length of time, which is capable of bringing it on at any feaon of the year. Thus, sheep that are long and hard driven, or such as are daily dragged from one part of the ground to another, eyes that are old, or old, and roughly handled and used by the women in milking, during the operation, where that practice is in use, and hog-sheep which are tired by driving through snow, in order to preferve their fatublence, are all liable to this affection of the eyes. That their eyes at firft become fore, and emit a fort of dry humour; after which a white film fettles over them, and if they continue to be fatigued, it grows thicker, the eyes appearing perfectly white; in which cafes, they are said to be proportionably longer in getting better. The difeafe, too, may proceed from many other caufes of different kinds, as all fuch as tend to caufe local inflammation in the parts, as cold, moisture, and many others of the fame fort.

In the cure of the difeafe, where it is infpefted to arise from the irritating powdery matter of flowers, the sheep should be immediately removed to other proper paturses for a time, until the danger from that caufe is over; and in cafes of snow-blindnefs of this kind, it is always proper to bring them down, as soon as possible, from the high snowly walks, where they occupy them, to the bare grounds below.

The inflamed veffels on the white of the eye, especially those next the nofe, are also sometimes advised to be cut with a lancet or sharp penknife every second morning; while the eyes are to be kept defended against the light, by a shade tied over the head, or a piece of crape over the eyes. The eyes may likewise be bathed two or three times a-day, with a solution of half a drachm of fugar of lead, or of two drachms of alum, and the fame quantity of white vitriol, in a pint of soft-water. At the fame time purgatives may be given internally, fuch as two ounces of some purging falt, or, what is better, a scruple of calomel, once a day for four or five times. When, by these means, the inflammation is got the better of, but the fliough still remains, a little ointment, compos’d of eight parts of some mild unctuous subfance, and one of red precipitate of mercury, made fine by rubbing, may be infuflated into the eyes every morning; or a little finely powdered crytal and leaf fugar be blown into them twice in the day.

With fome, it is at firft the practice to bleed the sheep below the eyes, and to let some of the blood run into each of them; but it is fuppofed that care will infallibly cure the difeafe in a space of time proportioned to the debility that
has induced the complaint without any thing else. The best and most proper means of cure in these cases are, in the first place, local or general bleeding, then the use of some such collusions and internal remedies as the above, after some time having recourse to stronger washes and powders of the same nature, with small quantities of opium, and keeping the animals all the while as much as possible from the light, and the glare of the ground. (See a paper in the third volume of the Transactions of the Highland Society of Scotland.) It is observed, that certain parcels of sheep are very liable to blindness of this sort; and that although it is not a fatal disease in itself, it frequently occasions considerable los by the sheep drowning themselves, or breaking their necks in falling down precipices and other such places.

White Flag, Flats, and Froth. See the substantives.

White Foot, in the Mange, called in French balzana, is a mark that happens in the feet of a great many horses, both before and behind, from the fetlock to the coffin. The horses thus marked are either trembled, crostremelled, or white all four. Some horsemen place an unlucky fatality in the white of the foot behind. See CHAUSSETTE, TREP HANT, and TRAMELLED.

White Friars, a name common to several orders of monks, from their being clothed in a white habit.

Such are, the regular canons of St. Augustine, the Premonstratensians, and Bernardines. See CARMELITES.

White Glaft. See Glass.

White-Hart Silver, candidi corvi argentum, a tribute or mulct paid into the exchequer, out of certain lands in or near the forest of White-hart, in Dorsetshire; which was continued from Henry III. this time, who first imposed it upon Thomas de la Linde, and others, for killing a beautiful white hart, which that king had purposely spared in hunting.

White Herbs. See HELLEBORE.

White Honeysuckle, in Agriculture, a term often applied to the white clover. It is flated, in the Agricultural Report for the County of Gloucester, to be a plant which is brought forward by manure and sheep-lock, and a proof of good land, at least of land in a high state of cultivation; and that, on this account, it has, when it abounds in dairy pastures, a tendency to raise the quality of the milk, and make the cheese more or less which is made from it. See DAIRYING, and WHITE CLOVER.

White Horse-Fish, in Ichthyology, a common English name for the raia alper noistras of Willughby, and the raia fulonica of Rondeletius and Linnaeus. Its back is rough and spiny; the nose is short and sharp; at the corner of each eye are a few spines; the whittling membrane is fringed; the teeth are small and sharp; on the upper part of the pectoral fins are three rows of spines pointing toward the back, and crooked, like those of the fuller's instrument; whence its name fulonica and fuller. On the tail are three rows of strong spines: the tail is slender, and rather longer than the body. The colour of the upper part of the body is cinerous, usually marked with many black spots; the lower part white. This fish grows to a size equal to that of the skate. Pennant.

White Jasper, in Mineralogy, or agate jasper, has a pale yellowish-white colour, and sometimes occurs reddish-white. It is opaque, and has small imperfectly conchoidal fractures. See JASPER.

White Land, in Agriculture, a tough clayey soil, naturally of a somewhat whitish hue when dry, especially when it has lain some time untilled, but becoming blackish after rain: this appears of a light greyish colour when turned up by the plough, and slides off from the plough-share with cafe, and with a smooth glossy surface. It has often a yellowish hue with the grey, and is very leaved with large parcels of a blue marly earth. See CLAY SOIL.

White Lead is a sort of rust of lead, or lead dissolved with vinegar; much used by painters. See LEAD, and CERUSE.

White Leaf. See CRATIGUS.

White Line, among Printers, a void space, greater than usual, left between two lines. See PRINTING.

White Line, in Anatomy. See LINEA ALBA.

White Linen is cloth of hemp, or flax, bleached by divers leys, and waterings on the ground.

White Manganes, in Mineralogy, manganece oxyde carbonaté, Haüy. Red manganece ore of some mineralogists. This ore occurs of various colours, from yellowish-white to rose-red. See ORES OF MANGANESE.

White Meats include milk, butter, cheese, white pots, curdlets, and other foods consisting of milk, or eggs. Some add, also, fish, veal, and chickens.

White Mortar. See MORTAR.

White Mulberry, in Rural Economy, a very fine cider-fruit in field fruit-gounds. This, with the fox-whelp, redscrew, and some others, are fine old fruits, but which are now going off, and afford the better cider, when mixed in the mill: the proportions in which they are to be used have never, however, been defined, but depend probably a good deal on the quantity to be ground at the same time.

White Mulberry, in Agriculture, a sort of plant which is often cultivated in the field for the use of the seed in different places.

The best sort of foil for it is that of the light loam, which should be well broken down and reduced by ploughing and harrowing. Some, on fresh broken up land, make a winter fallow for this crop.

It is mostly put in after a wheat-crop, but may succeed others where the land is clean and well prepared. In Kent, they strike furrows about eleven or twelve inches apart, and then sow the seed, two or three gallons to the acre, in the month of March.

The culture of it while growing is to hoe it, and keep it free from weeds, to set it out in the way of turnips, not too thick on the ground, as that draws up the plants weak. The crop is reaped about July. In some cases, it is laid in gavels or handfuls upon the stubble, in the same manner as cole-see. It is usually threshed out on a sail-cloth in the field.

The produce differs from eight to twenty bushels the acre.

It is a ticklish sort of crop, as one frosty morning will kill it, and it is liable to be injured and eaten by the black caterpillar; but when it turns out well is very profitable.

It is said not to exhaust the land much, which is greatly in its favour.

White Mickel-Crow, a term provincially applied to the rook in some cases.

White Order. See ORDER.

White Paper is that intended for writing, printing, &c., in contradistinction to brown paper, marbled paper, blotting paper, &c.

White, Pearl. See PEARL.

White Pepper. See PEPPER.

White Poplar, in Agriculture, a tree of the poplar kind, in which the wood is soft, but convertible to various uses in husbandry, as it grows quickly and bears cropping well. It is best grown in low situations, where the soil is of a clayey nature. It is sometimes called the ablee tree.
White Poppy, a plant sometimes cultivated in the garden and the field for the use of the opium which is obtained from its juice by means of evaporation. It might be largely cultivated in many situations with great advantage, as it contains this substance or principle in great abundance. See Papaver Album.

White Porcelain. See Porcelain.

White Pot, denotes milk or cream baked with the yolks of eggs, fine bread, sugar, and spice, in an earthen pot. The cooks furnish us with a variety of dishes under this form and denomination: such are, Norfolk white-pot, Westminister white-pot, rice white-pot, &c.

White Pottery. See Pottery.

White Precipitate. See Carbonate of Mercury.

White Pyrites, in Mineralogy; Fr. sulfure blanc, Haüy. The colour of this ore when pure is of a tin-white colour, passing into brads-yellow and steel-grey. It occurs in small octohedral crystals variously modified, also foliated and botryoidal. It is hard, brittle, and easily frangible. It melts before the blow-pipe, giving out a sulphureous vapour; it then acts on the magnetic needle. It decomposes much easier than common pyrites. It contains 46 parts of iron and 54 of sulphur. See Pyrites.

White Rent, in Rural Economy, a rent or duty of 8d. payable yearly, by every tenner in the counties of Devon and Cornwall, to the duke of the latter, as lord of the soil. See Blanch Fermé.

White Salt is common sea-salt dried and calcined by the fire, so as not to leave any moisture therein. The chemists call it decrystallized salt.

There are some salts naturally white, and others that need to be whitened, either by dissolving and purifying them in fair water, which is afterwards evaporated; or by means of fire; or by the sun. See Salt.

White Salt, a term applied to the fine purified salt, in contradistinction to that of the rock kind. The former is said in Cheshire to form a much more important object in the way of commerce than the latter. See Salt.

White Sarsaparilla, a root of fowle made of bleden almonds, and the brest of a capon, pound together with cloves, cinnamon, &c. We also hear of white broth, which is a broth of broth enriched with fack and spices, having blanded almonds feraped into it, and the whole thickened with the yolks of eggs, &c.

White Scour. See Scour.

White Silver Ore, in Mineralogy, an ore of silver always associated with lead and antimony. (See Silver Ores.) Dark white silver contains, according to Klaproth, 9.25 parts in the hundred of silver. Light white silver ore contains 20.40, associated with the same minerals as the dark ore, but in different proportions.

White Soap. See Soap.

White, Spanish, is a kind of fuscus used by the ladies to whiten their complexion, and hide the defects of it, called also magistery of bismuth.

The use of this, as well as of cerusses, is pernicious; and should be particularly avoided during the taking of any sulphureous water, which may change the complexion quite black. Indeed, all phlogistic vapours, and even the fire itself, tend to give both the magistery of bismuth and cerussa a yellow colour: an observation which serves to explain a pallage in Martialis, where a cerused lady is said to fear the sun.

"Cretata timet Fabulla, nimbus,
Cerufata timet Sabella, solem."

WHITE-SWELLING.

When a disease is attended with great varieties, not only with regard to its progress and symptoms, but also its causes, and the disorder which it produces in the parts which are the seat of it, there is as much difficulty in fixing upon a name that will convey an exact idea of it, as in offering a definition or description of it applicable to all the cases which may present themselves to the attentive observer. Such are the circumstances of the disease of which we are about to speak in the present article. Surgeons have given it a variety of appellations, derived from some one particular symptom with which it is accompanied. Thus, it has been called white-swelling, (a name which is still most generally adopted,) because the skin which covers it retains its natural colour, and exhibits no appearance of inflammation. It is also sometimes termed fungus articuli, on account of its softness and elasticity, which allow it readily to yield to pressure, but make it rise up again immediately when the compression is discontinued, like the fungous excrescences which grow upon the oak. The disorder is likewise often named by foreign writers the lymphatic tumour, or sereous swelling of the articulations, in consequence of the great quantity of thick lymph which appears to be effused in the cellular fibres round the ligaments, and upon the ligaments themselves. Sometimes the disease is called spina ventosa. (See that article.) The case is occasionally denominated a false ankylosis, because the diseased surface causes more or less interruption of the motions of the joint. Lastly, the dilatation is often called a rheumatic, or serofulous dislocation of a joint, according as rheumatism, or serofula, is suspected of being concerned in its origin.

White-swellings are usually defined to be chronic enlargements of the joints; circumscripted; without any alteration in the colour of the skin; sometimes hard, and resisting the pressure of the fingers; sometimes less firm, elastic, yielding to pressure, and afterwards rising up again in the manner of a fungus, which grows upon certain trees; sometimes so soft as to present a deceitful feel of fluctuation, although there is no fluid in the part. In particular instances, these swellings are indolent; but, most frequently, they are attended with great pain, especially when the joint is moved, so that the patient either cannot exercise the limb at all, or does it at the expense of considerable suffering, and with imperfect and difficulty. The disease has its seat in the ligaments, cellular fibres, synovial glands, cartilages, and even the bones. All these parts, however, are not affected in every instance; and sometimes the dilatation commences in the bones; sometimes in the cartilages and ligaments, according to the peculiarity in the nature of the case. The foregoing definition is obviously merely an enumeration of the principal symptoms of white-swellings, and is far from giving an exact idea of a disease which presents so many varieties in different individuals, that there are scarcely two patients to be met with in whom the complaint follows precisely the same course, or exhibits altogether similar phenomena.

There is no joint which may not be attacked by this intransite disease; but experience proves, that the ginglymoid articulations are more frequently affected than the orbicular. We are, however, except from this remark the articulation between the femur and os innominatum, in which the disease is very common, and often called by the French surgeons spontaneous dislocation of the femur, because the case generally terminates in a displacement of the head of the thigh-bone. (See Hip-Joint, Dislocation of.) Amongst the ginglymoid joints, the knee is oftener affected than any other. Then come the joints of the elbow, foot, and hand. White-swellings attack the small joints, like those of the fingers and toes, with far less frequency.

White-swellings may occur at every period of life; but they are more common in infancy and youth than in adults and old subjects. It is conceived also by some writers, that these cases begin more frequently in autumn and winter, or when the atmosphere is damp and variable, than in the other seasons. But the disease is on the whole so common in this climate, that it must be difficult to establish the truth of the foregoing conjecture.

The disease sometimes begins with a more or less acute pain in the articulation, usually extending along the fasciae and tendons of the neighbouring muscles. Sometimes the pain is of a dull kind, being superficial, seated in the soft parts, and reaching all round the joint. On other occasions, it is acute, deeply situated, and confined to a small space, which is most commonly the centre of the articulation. In particular examples, the swelling of the joint succeeds a pain which has been experienced in another part of the body, and suddenly ceased. Sometimes the disease begins in an unexpected manner, that the patient, who went to bed perfectly well, rises in the morning with a slight painful knee. Cases of the latter kind are generally rheumatic.

Whatever may be the manner in which the complaint originates, and whatever the circumstances which precede the attack, it always comes on in the form of a tumour, which presents the following characters:—The swelling seldom reaches all round the articulation; but is almost always limited to a more or less extensive portion of the circumference of the part. In the knee, it occurs above the patella, and also below this bone, at the sides of the ligament, which connects it with the tibia. In the elbow, it chiefly occupies the sides of the joint, especially the inner side. In the ankle, it takes place below and behind the malleoli. Lastly, in the fingers, it commonly affects the whole circumference of the diseased joint. Such swelling is circumscripted, immovable, and more or less hard and elastic, not retaining the impression of the finger, as in edema (see EDEMA), but generally communicating, when handled, a sensation of softness, which leads to a suspicion of the presence of a fluid, when none in reality exists. The swelling is more or less painful, especially when compressed. Sometimes, however, it is indolent; the heat of the part is not increased, and the integuments continue of their natural colour. The motion of the joint is impeded, and if the patient will not abstain from moving the part, he is put to an excruciating pain. There are some white-swellings of the knee, in which the leg is fixed in the extended posture; but, most commonly, the limb is bent, even in a considerable degree, and when an endeavour is made to straighten it, great suffering is excited. In white-swellings of the elbow, the forearm is constantly observed in a state of flexion. In those of the wrist, the hand has a strong propensity to fall into the bent position; and in order to prevent this occurrence, and hinder an incomplete luxation of the carpus from taking place backwards, the surgeon is sometimes obliged to support the hand upon a splint.

The constant flexion of the limb produces a considerable retraction of the flexor muscles and their tendons, together with a rigidity which can be felt through the integuments, and which extends far through the muscles and tendons, generally from the bones to the joints, and often further, as far as the skin. The total loss of exercise always arising from this state of the muscles and tendons, generally soon renders the joint stiff and motionless, so that it frequently has the appearance of being in a state of rcal and complete ankylosis. See ARTHRITIS.
WHITE-SWELLING.

The swelling may remain a long while in the condition which has been described; it may even cease to be painful; and it may cause only a serious weakness of the knee, and more or less difficulty in walking. But most commonly it continues to make uninterrupted progress; or, if its advances should happen to be checked, and the disease be for a time stationary, it frequently occurs, that, in consequence of a fall, a bruise, or even without any external cause, and, as it were spontaneously, the complaint afterwards increases again. The articulation swells more and more, and, if it be the knee which is affected, the hollow of the ham also swells up and becomes effaced. The pain likewise augments, being felt sometimes at one point of the circumference of the joint, sometimes at another; occasionally in the ham, and, in other examples, in the very cavity of the articulation. There are, however, some patients who feel no suffer little or no pain of any consequence. The hardness of the tumour is subject to great variety. The older the disease is, the more considerable is in general the degree of induration. Yet there are certain white-swellings which are extremely hard, although they have not existed a long while; and other cases which are very soft, notwithstanding they are of long standing. Boyer thinks, that this difference depends upon the heat of the disease, which is sometimes in the bones; sometimes in the ligaments and surrounding cellular membrane. The skin which covers the swelling grows thin, pale, and shining; the cutaneous veins become dilated and varicose; and the muscles of the leg waste and dwindle away, so that the size of this part of the limb is strikingly diminished. Sometimes, however, it is affected with oedema, and has the appearance of being enlarged. The lower part of the thigh also frequently undergoes a very considerable diminution. This wasting of the limb above and below the disease, makes the joint also seem much more swelled than it is in reality. Sometimes the lymphatic glands in the groin become enlarged and hardened; and when the disease makes much progress, the bones are frequently softened and carious, and the cartilages destroyed. Lastly, abscesses, more or less considerable, are formed in different parts of the tumour; and their formation is attended with a great deal of acute pain, inflammation, and fever. These abscesses are more or less deeply situated, and often communicate with the interior of the joint. When they burst, or are opened, a large quantity of matter is discharged, which is hardly ever of healthy consistence, being mostly a fatty-purulent yellowish fluid, somewhat resembling turbid whey, and containing flakes of albumen. Sometimes, however, it presents very nearly the appearances of healthy pus; but it soon changes into a thin fetid fumes of very bad quality. Its discharge, although very considerable, is followed by scarcely any perceptible diminution in the size of the swelling. The openings by which it escapes sometimes soon close, and fresh collections of matter ensue which burst of themselves, and then heal up like the former; but, in general, the apertures, instead of healing, become converted into incurable fistulae.

Mr. Brodie has paid considerable attention to the several diseases of the joints, which usually go under the name of white-swelling. In particular, he has carefully examined the morbid appearances which are found upon dissection; and his observations have led him to propose a classification of these diseases.

1. The first case which Mr. Brodie describes is, inflammation of the synovial membrane, which may occur as a symptom of a constitutional disease, where the fylene is affected with rheumatism; where mercury has been improperly exhibited, or in large quantities; or where there is general debility from any other cause. But, in these cases, the inflammation is seldom severe; it occasions an effusion of fluid into the joint, but rarely terminates in the extravasation of coagulating lymph, or thickening of the inflamed membrane. Sometimes it leaves one joint to attack another; or, it suddenly subsides without another joint becoming affected.

At other times, says Mr. Brodie, the inflammation occurs as a local affection produced by a sprain, the application of cold, or arising from no evident cause. It is then, for the most part, more severe, and of longer duration; it leaves the joint with its functions more or less impaired, and occasionally terminates in its total destruction. In itself, it is a serious disease; but it is often confounded, under the general name of white-swelling, with other diseases still more serious. In some cases, it assumes the form of an acute; but in the greater number of instances, it has that of a chronic inflammation.

When the case is acute, the skin is in general red, and the joint tender and painful. The pain, which is not confined to any particular point, and aggravated by motion of the limb, is soon followed by swelling. The patient is also affected with inflammatory fever. In a few days, the disease either subsides altogether, or assumes the chronic form.

According to Mr. Brodie, when the inflammation is chronic, the pain and tenderness are less, so that the patient is able to walk about, and often without experiencing any severe distress. There is no fever, and the skin retains its natural colour. The swelling also increases less rapidly than in acute cases. These symptoms are generally rendered worse by exposure to cold and exertions. In the first instance, the swelling of the joint arises entirely from a preternatural quantity of synovia. But when the inflammation has existed some time, the fluid is not so plainly perceptible, because the synovial membrane is now thickened, which likewise augments the stiffness of the articulation. The shape of the swelling is not that of the articulating ends of the bones, but arises chiefly from the distended state of the synovial membrane, and hence depends in a great measure on the situation of the ligaments and tendons, which yield it in certain directions. Thus, when the knee is affected, the swelling is principally observable in the same places where it occurs in cases of hydroptic articular.

After the inflammation of the synovial membrane has subsided, the fluid is absorbed, and, in some instances, the joint recovers its natural figure and mobility; but in the majority of cases, the stiffness and swelling continue. Whenever the patient is exposed to cold, or exercises the limb much, the pain returns, and the swelling is increased. Such cases are of frequent occurrence, and, as Mr. Brodie observes, they form a large proportion of those diseases which are called white-swellings.


2. The same gentleman has favoured the public with a very circumstantial history of another description of cases, where the disease originates in the synovial membrane, which loses its natural organization, and becomes converted into a thick pulpy substance of a light brown colour, intermixed by white membranous lines, and from one-fourth to one-half of an inch, or more, in thickness. As this disease advances, it involves all the parts of which the joint is composed, producing ulceration of the cartilages, caries of the bones, and
bones, waisting of the ligaments, and abscesses in different places. The complaint has invariably proved slow in its progress, and sometimes has remained nearly in an indolent state for many months, or even for one or two years; but Mr. Brodie informs us, that he has never met with an instance in which a real amendment was produced, much less a cure. (See Medico-Chir. Trans. vol. iv. p. 220, &c.) Mr. Brodie also remarks, that the above-described affection of the synovial membrane is rarely met with, except in the knee, and that it generally takes place in young persons under, or not much above the age of puberty. In the origin of this disease, there is a slight degree of stiffness and tumefaction, without pain, and producing only the most trifling inconvenience. These symptoms gradually increase, so that, at last, the joint scarcely admits of the smallest motion, the stiffness being greater than what is the usual result of common inflammation. The form of the swelling bears some resemblance to that in cases of inflammation of the synovial membrane; but it is less regular. The swelling is soft and elastic, and gives to the hand a sensation as it contained fluid. If only one hand be employed in making the examination, the deception may be complete, and the most experienced surgeon may be led to suppose that there is fluid in the joint when there is none; but if both hands be employed, one on each side, the absence of fluid is distinguished by the want of fluctuation.

"The patient experiences little or no pain, until abscesses begin to form, and the cartilages ulcerate; and even then the pain is not so severe as where the ulceration of the cartilages occurs as a primary disease, and the abscesses loco more readily, and discharge a smaller quantity of pus than in cases of this last description. At this period, the patient becomes affected with hectic fever, loses his flesh, and gradually sinks, unless the limb be removed by an operation." See Brodie's Obs. in Medico-Chir. Trans. vol. v. p. 251, &c.

3. Another form of white-swelling described by the same writer, is that which is more particularly characterized by ulceration of the articular cartilages. This change occurs in the advanced stage of several diseases of the joints, and it also exists in many instances as a primary affection, in the early stage of which the bones, synovial membrane, and ligaments, are in a natural state; but which, if neglected, ultimately occasions the entire destruction of the articulation. When ulceration of the cartilages occurs in the superficial joints, it constitutes one of the diseases which have been known by the name of white-swelling. From cases which Mr. Brodie has seen, he is led to conclude, that when it takes place in the hip it is this disease, which has been variously designated by writers, the "morbus coxarius," the "disease of the hip-joint," the "serofulous hip," the "serofulous cartes of the hip-joint," &c. At last, Mr. Brodie conceives, that it is to this disease such names have been principally applied, though he acknowledges that there are probably other morbid affections which have been confounded with it. (Op. Cit. vol. iv. p. 236.) The ulceration of the articular cartilages takes place as a primary disease, chiefly in children or adults under the middle age. "Of sixty-eight persons affected with this disease, fifty-fix (according to Mr. Brodie) were under thirty years of age; the eldest was an infant of about twelve months; the oldest was a woman of sixty-seven." As the knee is more frequently affected with inflammation of the synovial membrane, so is the hip more liable than other joints to ulceration of the cartilaginous surfaces. In general, the disease is confined to a single joint; but it is not very unusual to find two or three joints affected in the same individual, either at the same time or in succession. Sometimes the patient traces the beginning of his symptoms to a local injury; or to his having been exposed to cold; but, for the most part, no cause can be assigned for the complaint. See Medico-Chir. Trans. vol. vi. p. 319.

For a description of the disorder as it occurs in the hip, the reader is referred to the article Hip-Joint, Disease of. At present, we shall merely notice the symptoms which, according to the investigations of Mr. Brodie, particularly characterize ulceration of the cartilages of the knee. They differ from the symptoms of inflammation of the synovial membrane, by the pain being slight in the beginning, and gradually becoming very intense, which is the reverse of what happens in the latter affection. The pain also in the commencement is unattended with any evident swelling, which never comes on in less than four or five weeks, and often not till after several months. It is not to be inferred, however, that every slight pain of the joint unaccompanied with swelling, must of course arise from ulceration of the cartilages. But, says Mr. Brodie, when the pain continues to increase, and at last is very severe; when it is aggravated by the motion of the bones on each other; and when, after a time, a slight tumefaction of the joint takes place, we may conclude that the disease consists in such ulceration. The swelling arises from a slight inflammation of the cellular membrane on the outside of the joint; it has the form of the articulating ends of the bones; and for the most part it appears greater than it really is, in consequence of the muscles being wasted. No fluctuation is perceptible, as where the synovial membrane is inflamed; nor is there the peculiar elasticity, which exists, where the synovial membrane has undergone a morbid alteration of its structure.

Mr. Brodie, however, has explained, that, in some cases, the swelling has a different shape, and communicates the feel of a fluctuation. This happens when inflammation of the synovial membrane, attended with a collection of the synovia of the joint, or abscesses in the surrounding soft parts, or in the articulation itself, occur as secondary diseases. When there has been considerable destruction of the soft parts from abscesses and ulceration, the head of the tibia may become dislocated and drawn towards the ham. See Medico-Chir. Trans. vol. vi. p. 326, &c.

4. There is another species of white-swelling which is peculiarly different from others, in being attended with ulceration of the synovial membrane. As, however, it does not appear to us to need a description in a work not expressly devoted to surgery, we shall only add, that the reader may find Mr. Brodie's account of the cause in the Medico-Chir. Transactions. These white-swellings which are reputed to be serofulous, form a subject, however, on which we cannot be silent. In the serofulous diseases of the joints, the bones are primarily affected, in consequence of which ulceration takes place in the cartilages covering their articular surfaces. The cartilages being ulcerated, the subsequent progress of the disease is, according to Mr. Brodie, the same as where this ulceration takes place in the first instance.

It has been a very prevalent opinion, that, in cases of white-swelling, the heads of the bones are always enlarged. Mr. Ruffell is, perhaps, the first writer who expressed an opposite sentiment, and he absolutely declares, that he had never heard nor known of an instance, in which the tibia was enlarged from an attack of white-swelling. (On Diseases of the Knee, p. 37.) We believe, that a regular expansion of
of the heads of the bones, in cases of white-swelling, is frequently an unusual occurrence, although it may sometimes happen. It is frequent, however, to meet with a sort of enlargement, which arises from spicules of bony matter, deposited on the outside of the tibia, ulna, &c., which alteration is materially different from a regular expansion of the heads of those bones. We have, however, lately seen an instance, in which the upper head of the ulna is considerably increased in size by a regular kind of expansion. The preparation is in Mr. Abernethy's museum; and a few other specimens we have, believe, been occasionally noticed. Yet, as a general fact, we may still remark, that an enlargement of the heads of the bones in the diseased called white-swelling, is far from being the usual state of things. The change which the head of the tibia undergoes in many cases, is first a partial absorption of the phosphate of lime throughout its texture, while a soft kind of matter is secreted into its substance. In a more advanced stage, and, indeed, in that stage which most frequently takes place before the limb is amputated, there are deep excavations in the head of the bone, arising from caries, and its structure is now so softened, that when a probe is pressed against the carious part, it readily penetrates deeply into the bone.

Mr. Brodie also joins in the opinion, that the morbid affection has its origin in the bones, "which," he says, "become preternaturally vascular, and contain a less than usual quantity of earth, while, at first, a transparent fluid, and afterwards a yellowish cheesy substance, is deposited in their cancelli. From the diseased bone, vessels, carrying red blood, shoot into the cartilage, which afterwards ulcerates in spots, the ulceration beginning on that surface which is connected to the bone." Med. Chir. Tranf. vol. iv. p. 272.

With respect to the expansion of the heads of the bones, we ought to have mentioned, that the late Mr. Crowther entirely disbelieved the reality of the occurrence, and every body knows, that he paid very considerable attention to the subject. (See Praef. Obf. on White-Swelling, &c. edit. 2. p. 14.) The event, however, should have been described as unusual, and not as never happening, since, as we have already stated, a few specimens of such a change have now been collected.

Mr. Ruffell has particularly noticed how much the soft parts frequently contribute to the swelling: "the great mass of the swelling," he observes, "appears to arise from an affection of the parts exterior to the cavity of the joint, and which, besides an enlargement in size, seems also to have undergone a material change in structure. There is a larger than natural proportion of a viscid fluid, intermixed with the cellular substance; and the cellular substance itself has become thicker, softer, and of a less firm consistence than in a state of health." (On the Morbid Affections of the Knee, p. 30.) The manner in which the soft parts are affected is also described by Mr. Brodie. "Inflammation takes place of the cellular membrane, external to the joint. Serum, and afterwards coagulable lymph, are effused; and hence arises a puffy elastic swelling in the early and an edematous swelling in an advanced stage of the disease. Scrofula attacks only those bones, or portions of bones, which have a spongy texture, as the extremities of the cylindrical bones, and the bones of the carpus and tarus; and hence the joints become affected from their contiguity to the parts which are the original seat of the disease." Med. Chir. Tranf. vol. iv. p. 273.

All white-swellings which make considerable progress, and occasion fever, pain, long confinement, abscesses, &c. unavoidably bring on that impairment of the general health, which is well known by the name of hectic fever. The patient gradually loses his appetite and natural rest and sleep; his pulse is small and frequent; an obstinate debilitating diarrhea, and profuse nocturnal sweats, ensue. Such complaints are sooner or later followed by dilatation, unless the constitution be relieved in time, either by the amendment or removal of the diseased part. In different patients, however, the course of the disease, and its effects upon the system, vary considerably in relation to the rapidity with which they occur.

Rheumatic white-swellings are very distinct diseases from the scrofulous disfigure of the large joints. In the first, the pain is laid never to occur without being attended with swelling. Scrofulous white-swellings, on the other hand, are always preceded by a pain, which is particularly confined to one point of the articulation. In rheumatic cases, the pain is more general and diffused over the whole joint.

It seems probable, that all cases in which the structure of the bones is found quite undiseased, and in which all the mals of disease appears to be confined to the soft parts, are not scrofulous white-swellings. Few persons who have attained the age of five-and-twenty, without having had the leaff symptom of scrofula, ever experience, after this period of life, a first attack of the white-swelling of the scrofulous kind. All cases, in which the internal structure of the heads of the bones becomes softened, are probably scrofulous.

Mr. Ruffell has noticed the frequent enlargement of the lymphatic glands in the groin, in consequence of the irritation of the disease when in the knee; but, he justly adds, that this secondary affection never proves long troublesome.

When the bones are diseased, the head of the tibia always suffers more than the condyles of the thigh-bone. (Ruffell.) The articular surface of the femur sometimes has not a single rough or carious point, notwithstanding that of the tibia may have suffered a great deal. The cartilaginous coverings of the heads of the bones are generally eroded first at their edges; and in the knee, the cartilage of the tibia is always more affected than that covering the condyles of the thigh-bone. Indeed, when white-swellings have their origin in the bones, and the knee is the seat of the disorder, there is some ground for supposing that it is in the tibia that the morbid mischief first commences.

The ligaments of the knee are occasionally so much weakened or destroyed by this terrible malady, that the tibia and fibula become more or less displaced backward, and drawn towards the tuberosity of the ischium, by the powerful action of the flexor muscles of the leg.

We have seen a curious species of white-swelling, in which the leg could be moved to each side with a very considerable distance, both when the knee was extended and bent. Such a state implies a preternatural looseness of the ligaments of the articulation.

Scrofulous white-swellings, no doubt, are under the influence of a particular kind of constitution, termed a scrofulous or scrofulous habit. In this sort of temperament, every cause capable of exciting inflammation, or any morbid and irritative state of a large joint, may bring on such disorder as may end in the severe disease of which we are now speaking.

In a man of a found constitution, an irritation of the kind alluded to might only induce common healthy inflammation of the affected joint.

In scrofulous habits, it also seems probable, that irritation
tion of a joint is much more easily produced than in other constitutions; and no one can doubt, that when once excited in the former classes of subjects, it is much more dangerous and difficult of removal than in other patients.

The doctrine of particular white-swellings being serofuluous dilates, is supported by many weighty reasons, the opinions of the most accurate observers, and the evidence of daily experience. Wifeman (book iv. ch. 4.) calls the spina ventosa a species of serofula, and tells us, that infants and children are generally thse subjects of this disease. The disorder is said by Severinus to be exceedingly frequent in young subjects. Petrus de Marchetti has observed both male and female subjects affected with what is called rheumatic dilates of the joints, as late as the age of five-and-twenty; but not afterwards, unless they had suffered from serofula before that period of life, and had not been completely cured. R. Lowerus also entertains a similar opinion. Even though a few persons may have serofulous dilates of the joints, for the first time, after the age of twenty-five, this occurrence, like the first attack of serofula after this period, muft be considered as extremely uncommon.

Another argument in favour of the doctrine, which fets down particular kinds of white-swellings as serofulous, is founded on the hereditary nature of fuch forms of disease. Numerous continental surgeons, particularly Petit and Brambilla, have noticed how very fubjeé the English are both to serofula and white-swellings of the joints. We every day fee, that young persons afflicted with the present dilate, are generally manifestly serofulous, or have once been fo. Very often enlarged lymphatic glands in the neck denote this fatal peculiarity of constitution; very often the patients are known to have descended from parents who had ftraneous disorders.

Besides the general emblems of a serofulous constitution, we may often observe a shining, coagulated flaky subfiance, like white of egg, blended with the contents of fuch abfceses as occur in the progress of the dilate. This kind of matter is almost peculiar to serofulous abfceses, and forms another argument in fupport of the foregoing obfervations relative to the fhare which serofula frequently has in the origin and course of many white-swellings. Cooper’s Dict. of Practical Surgery.

The caufes of white-swellings are divided by surgical writers into external and internal. Amongf the former are reckoned mechanical injuries of the joints, fuch as wounds, contusions, sprains, immoderate exercife in cold damp weather, refining continually in a low humid situation, &c. It is certain, however, that these tumours are feldom produced altogether by external caufes; and even when their formation has been preceded by some external violence, this is rather to be regarded only as the determining caufe of the dilate, while the real caufe in this, as well as in other caufes where the complaint begins spontaneously, is of an internal kind. Rheumatifm and serofula are the ordinary caufes of white-swellings; and it may be alleged, without risk of error, that more than three-fourths of these tumours are owing to thofe constitutional dilates. Thofe white-swellings which attack ftrong phlegmatic subjects of adult age, commonly depend upon rheumatifm; while other caufes which happen in children, are almost always caufed by serofula. It is well known that rheumatifm is particularly difposed to make its attack upon the large joints, and that it especially affects the ligaments and neighbouring cellular fubfance, which it thickens and hardens, by caufing an effufion of coagulable lymph. Hence, fays Boyer, in such white-swellings as arife from rheumatifm, thofe parts of the dilate are found difeased in the early stage of the complaint. Traité des Mal. Chir. t. iv. p. 501.

With refpect to serofula, every surgeon is aware that it frequently attacks the heads of the bones, particularly in children, occafioning thofe morbid changes which we have already endeavoured to defcribe. We have likewise mentioned what is now generally admitted, that in white-swellings originating from serofula, the dilate commences in the bones, the foft parts becoming affected only fecundarily. The contrary is faid to happen in all rheumatic dilates, the dilate beginning in the foft parts, and only affecting the bones in a subsequent advanced state of the complaint.

The prognosis in caufes of white-swelling is, generally speaking, unfavourable; but it is more or lefs fo, according to the caufe of the dilate, its duration, the accompanying symptoms, the patient’s constitution, &c. White-swellings arifing from rheumatifm are the leat alarming, especially when they are recent. The progrefs of the complaint may then be often flopped, and fometimes a perfect cure accomplished. In this kind of cafe, the joint fometimes returns to its natural state, and regains the power of freely performing every motion; while in other infanfies, it continues affected with a greater or leffer degree of stiffness. White-swellings, which appear to depend altogether upon an external caufe, in persons in other refpects healthy and found, may terminate well. The worth white-swellings of all are thoé which originate from serofula; for they are very feldom cured, and when they do admit of amendment, the joint is always left in a state of anchylosis.

Whatever may be the caufe of white-swellings, when they are of long standing, severely painful, the bones ftoned and rendered carious, the cartilages ulcerated, the articulation filled with fumanious matter, and abfceses have formed, the openings of which continue fiftful, and emit a more or lefs abundant quantity of a thin fetid discharge, the dilate is in general incurable. In this cafe, the violence of the pain, the hectic fever, the profufe fweats, and colliquative diarrhoea, plunge the patient into a state of marasmus, and foon carry him off, unlefs an attempt be made to fave him by the timely performance of amputation. Yet, as Boyer observes, in some few cafes of this hopeless defcription, nature, skilfully aided by art, has been known to subdue the dilate. The fuppuration then gradually diminishes and affumes a better quality, the low fever, nocturnal perpirations, and weakening diarrhoea, entirely ceafe, the appetite returns, digestion is well performed, the strength is restored, and the patient gets well with an anchylosis. But fuch fortunate cafes are extremely uncommon, and they do not justify us in leaving the dilate to nature, instead of amputating the limb. Traité des Mal. Chir. t. iv. p. 505. 507.

Of all the dilates which fall under the care of the surgeon, there is not one in which a greater variety of remedies has been propofed than in white-swellings. Yet, notwithstanding the numerous means which are occasionally tried, the practitioner feldom has the mortification of finding, not only that he cannot accomplish a radical cure, but that he cannot even palliate the complaint, moderate its violence, or retard its progrefs.

The surgeon, in order to be methodical, fould adapt the treatment to the particular form of the dilate and its different ifates. But, in every ifate, perfect relief of the limb is absolutely indifpenfable, as exercife always has the effect of keeping up pain and irritation, and doing harm, whatever may be the species of the dilate.
WHITE-SWELLING.

Rheumatic white-swellings being invariably accompanied, at their commencement, with an inflammatory character, there can be no doubt, that, at this period of the complaint, the great indication is to take such measures as are best calculated to leffen and subdue inflammation; and bleeding is what should first be practiced. When the patient is strong, robust, and much fever exists, he may be bled once or twice in the arm; but, in other cases, we are to be content with drawing blood from the part affected with leeches, or by cupping. If leeches be used, they should be applied to both sides of the joint, and eight or ten ounces of blood ought to be thus taken away. The application of these animals should also be repeated at proper intervals, more or less frequently, according to the violence of the symptoms, and the strength of the patient. In cases of this description, drawing blood from the diseased part itself is found to be much more efficacious than general blood-letting, which weakens the patient without proportionately lefiening the swelling of the joint.

Blisters are another means, as efficacious as topical bleeding. Boyer recommends beginning with the application of a small one to the front of the joint, where the leeches have not been put; and he says, that it should be kept open, until the bites of the leeches are healed on one fide of the articulation, where a second blister is then to be applied. As soon as this is nearly healed, we are next advised to lay a third blister on the opposite fide of the joint. By thus continually changing the situation of the blister from one fide of the articulation to another, a permanent counter-irritation is kept up, which, says Boyer, in all deeply-seated inflammations, especially those which proceed from rheumatism, is much more effectual, than carefully maintaining a discharge from a single blister.

In conjunction with the foregoing means, the limb should be kept moderately and uniformly warm by covering it with flannel; a low diet is to be observed, cooling beverages preferred, and the action of the bowels regulated by emollients. Thus, the severity of the pain may generally be lefiened, and the inflammation diminished. If the pain, however, should still continue to be violent, Boyer recommends the use of topical anodyne and narcotic applications. He states, that, in this circumstance, he has often employed with success opiate and camphorated liniments; fomentations composed of a solution of the extract of opium in water; a strong decoction of poppies, &c. He thinks, however, that such applications should never be used, unless the pain be very severe.

When the inflammatory flage is over, topical refulent remedies are to be employed, and their effect is to be promoted by exhibiting mild opening medicines at suitable intervals. The most effectual refulent applications, and those which are most commonly tried in these cases, are, dry fritations with a piece of flannel, impregnated with the vapour of benzoin, liniments containing ammonia and camphor, ammonial of salicylic acid; but Boyer affirms, that he has often tried the last application, and that his experience leads him to impute whatever benefit arises from its employment, chiefly to the frictions, which reden and promote the circulation in the skin.

By a perseverance in the judicious use of the means above specified, rheumatic white-swellings may sometimces be cured; but it often happens, that, after the pain and swelling have subsided, the joint remains quite fluff and motionless, and every attempt to move it causes considerable suffering. In the majority of cases, such fluffiness depends almost entirely upon the retraction of the muscles, tendons, and ligaments, and demands the fame treatment as a false ankylosis. See ANKYLOSIS.

When the disease relieves the foregoing treatment, and is of long standing, the cure is more difficult, inasmuch as the thickening of the ligaments, and the effusion of a fero-albunaminous fluid into the cellular subflance around them, are more considerable, and the bones and cartilages are likewise at the fame time affected. In this circumstance, if there be any hope of cure, the surgeon must have recourse to more powerful means, which we shall mention in speaking of the treatment of other descriptions of white-swelling.

In white-swellings, arising from an external cause, such as blows, falls, &c. we must first leffen the inflammation by general and local bleeding, low diet, cooling aperient beverages, fomentations, and emollient anodyne poultries. Afterwards, when the pain and tension have subsided, refulent applications are to be used, and the patient is not to be allowed to move the limb, as long as there is any danger of a renewal of the pain and irritation by exercise.

Serofulous white-swellings in an early stage present different indications, according to the circumstances with which they are accompanied. A fall, or blow upon a joint, being sometimes the exciting cause of these tumours, any accident of this kind in a perfon evidently disposed to fero-albumin. demands the utmost attention and care. No means should be neglected which are at all likely to leffen the pain and irritation in the affected joint, and in particular the limb ought to be kept perfectly quiet for a long time. Serofulous white-swellings frequently come on, as it were, spontaneously, without the concurrence of any external accident, and their attack is attended with a dull, sometimes an acute pain in the very cavity of the joint, which at first is not affected with any manifest degree of swelling. In this circumstance, the surgeon must endeavour to prevent the progres of the disease by enjoining the patient to refrain from moving the joint, and by directing the employment of soothing local applications, which are afterwards to succeed by blisters, or an infus.

In the cases of white-swelling, which appear from Mr. Brodie’s account to depend principally upon inflammation of the synovial membrane, the acute flage of the disea is to be treated by general and local bleeding, aperient medicines, cold topical applications, or fomentations, and emollient poultices. When the affection has become chronic, this gentleman recommends perfect rest, and leeches, or cupping, followed by the application of a large blister. Under this treatment, he says, “the pain is relieved, and, in a few days, the swelling, as far as it depends upon the fluid collected in the cavity of the joint, is much diminished. Even where the tumour is solid, arising from the effusion of coagulating lymph, it will in a great measure subside, and sometimes be entirely diffipated, provided the lymph has not yet become organized. A single blister often produces marked good effects; but, it is generally necessary to repeat both the blister and the blood-letting several times.” Mr. Brodie considers the repeated application of blisters more efficacious, than a single blister kept open with the astringent cerate. When the inflammation has been much jub-ded, he thinks moderate exercise of the joint rather beneficial, and commends the use of a stimulating liniment, composed of 3f of olive oil, and 3f of sulphuric acid. This application, when too irritating, is to be weakened by an additional quantity of oil, and it is not to be used before inflammation.
flammation is subdued, left it aggravate the disease. Iffues
and fetons, which are useful in ulceration of the cartilages,
Mr. Brodie deems ufeles in the prefent difeafe. Plafters
of gum ammoniac, and others of a fimilar nature, are of
little efficacy while inflammation exists, but afterwards they
are of ufe in guarding the joint from the influence of exter-
nal cold, and preventing a relapse. For the removal of a
moderate degree of swelling and iffues, left by the past
inflammation, Mr. Brodie entertains a favourable opinion of
exerifce of the limb, and friction with camphorated mercur-
ial ointment, or by the hand with finely powdered flarch.
When the friction, however, produces inflammation again, it is
to be discontinued, and leeches applied. When the swelling
and iffues are confiderable, Mr. Brodie has never seen friction
do much good, and, as it is in fuch cafes particularly apt to
bring on inflammation again, it is to be employed with much
cautions. According to the fame author, friction is more
efficacious, where the iffues of a joint depends on a con-
tracted flate of the muscles, or tendons of the limb, or on
these being glued to each other, or the surrounding parts,
where it is the confquence of difeafe of the joint itfelf.
In fome cafes, the pumping of warm water on the part,
from a height of ferveral feet, as practifed at fome of the
watering places, is beneficial; but in this plan, the fame
cautions are neceffary, as in the employment of friction.

With regard to the cafes which Mr. Brodie describes as
depending upon a total los of the natural structure of the
fynovial membrane, which is converted into a pulp'y sub-
fance, one-quarter, or one-half, of an inch in thickness, are,
according to this gentleman, quite incurable, and they at
length terminate in ulceration of the cartilages, abfcesses,
&c. Hence, when the health begins to fuffer, he confiders
amputation proper. See Medico-Chir. Tranf. vol. v.

When white-feellings are accompanied with ulceration of the
cartilages, all motion of the joint is extremly hurtful.
Indeed, as Mr. Brodie obferves, keeping the limb in a
flate of perfect quietude is a very important, if not the moft
important circonfstance to be attended to in the treatment.
According to the fame writer, it is in fuch cafes, in which
ulceration of the cartilage occurs as a primary difeafe, that
caucfly iffues are ufually productive of fingular benefit;
but he deems them of little ufe in any other difeafes of the
joints. He thinks fetons, and bliflers kept open with the
famine cerate, may alfo be ufed with advantage in the fame
defcription of cafes. Bleeding can only be proper, when,
from the bad effects of exerifce, the articular surfaces are
infamed, and pain and fever prevail. Mr. Brodie affures
us, that the warm-bath relieves the fymptoms in the early
flate, if it does not flop the progres of the difeafe; but
he condemns plafters of gum ammoniac, embrocations,
liminants, and frictions, as either ufeles or hurtful. Op.
Cir. vol. vi.

The pumping of warm water upon difeafeed joints is a
method which is at prefent very frequently adopted, as
fome conceive, with decidedly benefical effects. The plan
is not altogether modern. Le Drian, and feveral other old
practitioners, recommend throwing warm water upon dif-
eafeed joints, and they prove the advantages of this treatment
by a relation of many ufeeful cafes. In order to derive
the greatest pofible good from the plan, the water fhould
be as warm as the patient can bear it, and it ought to fall
upon the part from a height of feven or eight feet. The
size of the flream muft alfo vary according to the degree of
fenfibilitv in the tumour. When the pain is acute, the end
of the pipe muft be closed with a piece of tin, perforated by
many holes, like the pofnt of a watering-pot. But when
the pain is inconsiderable, the pipe may terminate in a fingle
opening, the diameter of which fhould vary from half an
inch to an inch, according to circonfances. The applica-
tion is frequently to be continued nearly an hour, and when
it is finifhed, the patient ought to go to bed, and the joint
be covered with bladders filled with water as hot as the
patient can bear. Boyer recommends the application of the
bladders to be perforeed in for the space of two hours,
after which they are to be removed, and perfpiration from
the part promoted by covering it with warm cloths, or
flannels. In the evening, the bladders are to be repeated for
fome hours. The dafhing of warm water againft the dif-
eafeed joint is to be praftised every day, or every other day,
according as the patient can bear the plan, without too
much fatigue or inconvenience. This treatment, fays
baron Boyer, is proper in all kinds of white-feellings, and
in every flate of the difeafe; but it is much the moft ufe-
ful in fuch cafes in which the foft parts alone are afccted,
and at an early period, before the complaint has made great
progres. Favourable effects may be expected from this
method, when, after each application of the water, the part
affected perforates copiously, when it grows gradually
lofter, and when, after a certain number of trials, the
feeling begins to diminish. Under thefe circonfances,
the plan is to be continued and repeated very often, as a
long perseverance in it has frequently produced extraor-
dinary cures. When none of the above-defcribed changes
happen, little benefit can be hoped for from the method;
but if the patient fhouid not abandon it, before its ineffi-
cacy has been proved by adequate trials.

When there is no ufitable apparatus for applying the
warm water, it may be injected against the part with a lar-
gaffe, which has a pipe about half an inch in diameter,
made with four or five holes, for the difcharge of the fluid.
The injections may be rendered more or lefs active, by pro-
PELLING the water with more or lefs force.

Thefe affufions operate only by the heat and fhrength of
the current of water. Boyer fates, that their activity may
be augmented by adding to the fluid a quantity of the
mariate of soda or mariate of ammonia, or fome potaffa or
foda; and he thinks it will better to employ a fulphured
mineral water, either natural or faftications. The activity
of the affufions may also be increafed by heating the water
to a high temperature, letting it fall from a confiderable
height, and making the flream large. It is a plan, fays
baron Boyer, adapted to thofe white-feellings which are
fluated in the foft parts on the outside of the joints; and
which are indolent, and unattended with much pain. When
these active affufions are applied to white-feellings which
are painful, and which affect the bones, they often increafe
the patient's fufferings, and accelerate the progres of the

Of late years, furgeons have frequently made trial of dry-
rubbing, as it is termed, or friction of the joint, performed
with the hand, for ferveral hours a day, with the mere
application of a little powdered flarch, or hair-powder, in order
to prevent the part from being chafed. It is a method
which was firft praftised to a confiderable extent at Oxford,
and with great ufccefs. Many poor women there earned
a livelihood by rubbing difeafeed joints at the rate of fifpence
per hour. Indeed, there can be no doubt, that, in indolent
rheumatic white-feellings, fimple friction often removes the
feeling in an expeditious manner, as well as the iffues of
the afccted joint. The plan, however, will not effed a cure
in feroftulous cafes; nor can it be adopted without manifest
harm
In chronic cases, the swelling may also be lessened, and
the complaint sometimes much benefited by pressure, made
either with strips of adhesive plaster, or with bandages.
This method will not do much good in instances where the
bones are diseased, nor is it applicable to cases which are
irritable, or attended with heat and inflammation.

For eczematous white-swelling, and ulcers, which cannot yet be
said to have discovered any effectual or certain means of
relief; and these melancholy diseases frequently compel the
patient to submit to amputation, as the only thing by which a
long train of sufferings can be arrested, and the term of
life extended. The common plan of treating eczematous white-
swellings is, by topical bleeding, fomentations, and cold
applications, when they are attended with much pain, heat,
and inflammation; and by infusions, fomentations, and blisters,
in other periods of the disease. The cautery and moxa have
also been much employed abroad; and as everybody knows,
they were favourite and powerful remedies in the hands of
the ancients. In this country, the use of actual fire in sur-
gery is nearly, if not quite, exploded, on the ground that its
employment is attended with an appearance of cruelty, and
that infusions, made with caustic, are equally efficacious.

Pouteau, an eminent French surgeon, will ever be famous
for having revived in his own country all the ancient part-
tiality to burning iron. He recommended their use for all
white-swellings without discrimination; and the accounts
which he has left of the success of the practice are furi-
posing, if not incredible. In fact, they are in all proba-
bility greater exaggerations; for we find that baron Boyer,
one of the most eminent surgeons at Paris at the present
time, decidedly declares his opinion, that Pouteau's descrip-
tions of the efficacy of the actual cautery in the cure of
white-swellings do not correspond with the results of mod-
ern experience. Boyer himself gives a preference to the
moxa, which is a cone of cotton, burnt upon the diseased
part, so as to produce an effect. We confess, that to us
this plan seems to have no material difference from the
cautery; and, what is it but the application of actual fire
in another form? Indeed, one cannot help thinking, that
Boyer decries the cautery, only for the purpose of after-
wards recommending the moxa, which is now a more
fashionable means employed in French surgery. It is
curious to find Boyer particularly forbidding the use of
infusions, and the moxa in cases of white-swelling, where the
bones and cartilages are diseased; the very cases in which
Mr. Brodie, in common with the generality of surgeons in
England, expressly recommends either infusions or perpetual
blisters. Boyer has never seen much good arise from infu-
sions in any cases, although, as he affirms, he has made exten-
sive trial of them. The time also when he thinks the moxa
useful, is in that stage of the inflammation which intervenes
between the prevalence of inflammatory symptoms, and the
commencement of diseaee in the bones and cartilages.
Sometimes, however, the disorder certainly has its very
origin in the bones themselves.

The late Mr. Crowther introduced the plan of applying
open blisters with the fawine creside, which is a method fre-
quently attended with great success in chronic white-
wettlings, and sometimes appears to check the progress of
the eczematous form of the diseaee. Blisters may be kept
open with this ointment a long time, and with less pain,
than what proceeds from the use of the unguentum cattia;
and other stimulating dressings. It also occasion no risk of
bringing on manmury, or inflammation of the bladder and
stomach, or the upper parts of the body, or the head,
winding organs, like the use of ointments containing can-
Vol. XXXVIII.

tharides. In our opinion, Mr. Crowther had much merit
in making known the eligible qualities of the fawine creside;
and, we believe, no better application for keeping up a dis-
charge from blisters will ever be found. Sometimes, how-
ever, the repeated application of blisters has more effect
upon white-swellings, than a single blister kept open. This
is a circumstance which the practical surgeon ought con-
fantly to remember.

We might enlarge this article with observations on infec-
tions and fester, which are frequently employed in these cases;
but it would be superfluous, as they have been already
described in other parts of the work. See Issue, and
Seton.

It may be supposed, that eczematous white-swellings
will require the exhibition of the remedies usually
administered in cases of fcrupula. (See SCHROFULA.)

Boyer, and some other writers declare, that this is actually
the case. We have never seen these remedies, however, do
any good to diseased joints, if we except sea-air, sea-bathing,
and the use of sea-water lotions and poultices, which some-
times prove useful.

After all, we must acknowledge that white-swellings, we
mean particularly the infusions accompanied with ulceration
of the cartilages, and diseased heads of the bones, are
cases which too generally baffles the utmost skill, and render
a formidable operation unavoidable.

White Tail. See Motacilla Gannike?
White Tartar. See Tartar.
White Thorn. See CRATEEGUS.
White Thorn, or Hawthorn. See HEDGE, and Quick-
set-Hedge.

White-Throat, in Ornithology, the name of a small bird,
very common in our gardens and hedges, and seeming to
have been described under the name of flchipa by Aldro-
vandus and some others, though most approaching to the
fideula claus.

Its beak is black above, and whitish below; its feet of a
yellowish-brown; its neck and back are of a brownish-grey;
its head more grey than either, and the upper part of the
throat white, the rest reddish; its breast and belly are also
a little reddish; but in the female, the breast is perfectly
white. The edges of the long wing-feathers are some
whitish and others brownish, and the tail is variegated
with black and white, and some grey or ash-colour intermixed.
It is extremely common in our gardens and orchards in
summer, and feeds on flies, spiders, and other insects, but
leaves us in winter. It builds in bushes, at a small height
from the ground, with fluffe and horse-hair, and lays five
brownish-green eggs, with black spots. Its note is con-
tinually repeated, and often attended with odd motions of
the wings: it is harsh and displeasing. This bird is shy
and wild, and feeds of a pugnacious disposition. Ray and
Pennant. See Motacilla Sylvia.

White Trefoil, in Agriculture, is said, in the third volume
of the Effays of the Highland Society of Scotland, to be a
humble but sweet plant, which delights in a dry found field,
properly cleaned and limed; and is alone the delight of
sheep. But that a mixture of it, and of the seeds of rye
and rib grafe, constitutes one of the best sheep-pastures
that can be formed by the industry of man. That this sort
of grafe is likewise perennial, and that it enriches instead of
improving the soil or land. This has generally been
noticed
noticed to be the most abundant plant in such rich improved pastures; but that it has seldom been seen in lands remarkable for inducing the rot among sheep. See Rot, Sheep, and White Clover.

White, Troy. See Troy-White.

White, Varnish, and Vitrifi. See the substantives.

White, Vitrifi, in Mineralogy, a natural salt or ore of zinc. (See Zinc, and Zinc Ores.) This ore is a sulphate of that metal, but is frequently combined with a small portion of manganese. It is supposed to be formed naturally by the decomposition of blende or sulphur of zinc.

White, Wadding, Roughcast. See Wash for, &c.

White Water, a disease in Sheep, of the dangerous floramic kind. It is said to be caused by their feeding on rich succulent food in cold frostly seasons, or at other times, and by many other such causes; and is probably an affection of the inflammatory kind.

It is remarked in the Gloucester Report on Agriculture, that the white water is a destructive disorder on the Cotswolds; usually comes on with rapidity, and sometimes terminates with death in three hours. It is supposed to be owing to their licking up the white froth on their green food in spring and autumn. Folding at night on bare ground, giving them dry meat in the morning, and keeping them from the turnips till the froth is gone, is the obvious mode of prevention, if the foregoing cause be well founded.

If, however, the disorder be owing to going themselves with watery food, such as turnips, it is probable that to keep them moving, without suffering them to rest long, nor feed with what they have eaten, will carry off the beginning complaint; and even the white froth has been the occasion, this is the best remedy that reasoning suggests; and it is said to be the practice of the shepherds in Northumberland, in the management of the sheep under this complaint.

It is probable that speedy evacuation, both by bleeding and purging, may be found useful in this disease; and afterwards the use of floramic remedies.

It is found to chiefly attack the young healthy sheep. See Water, Red and Black.

White Water-Lily, in Gardening, a most beautiful plant of this country, which is capable of being propagated in artificial and ornamental pieces of water in gardens and pleasure-grounds, merely by transplanting the bulbous roots of it in the winter season. It is perennial in its nature.

White Wax is yellow wax blanched, and purified by the fun and dew. See Wax.

White upon White, in the Porcelain Manufactory, a name given by the English merchants to a particular china-ware, which is formed of three different white sublunates, the body being one, the flowers of another, and the varnish which covers thee of a third. See Soap.

White Wine is that of a clear, bright, transparent colour, bordering on white. It is thus called to distinguish it from the red wines, or claret.

The generality of white wines are made from white grapes; though there are some from black ones, only the skins are carefully kept from tainting them. See Wine.

Whites, the popular name of a disorder incident to women. See Fluor Albus.

White, in Geography, a county of West Tennessee, with 4238 inhabitants, including 283 slaves.

White Bay, a bay on the east coast of Newfoundland. N. lat. 50° 10'. W. long. 56° 25'.—Also, a bay on the east coast of Kerguelen's Land, south of Point Pringle, so called from some white spots of land or rocks. In the bottom are several smaller bays or coves. S. lat. 47° 53'. E. long. 60° 15'.

White Bear Lake, a lake of North America, said to be the most northerly of those lakes which supply the Mississippi. It is about 60 miles in circumference. N. lat. 45° 50'. W. long. 95° 30'.

White Cliff, or Culver Cliff, a cape of the east coast of the Isle of Wight. North of it is a bay called White Cliff Bay. N. lat. 50° 39'. W. long. 56°.

White Deer, a township of Pennsylvania, in Northumberland county, on the Susquehanna, with 1232 inhabitants.

White Flag Bay, a bay on the west coast of the island of St. Christopher; 2 miles N. of Sandy Point.

White Head, a cape of Ireland, on the coast of Antrim, at the entrance into Belfast Lough, a little to the south of Black Head.

White Hills, a fishing-town of Scotland, in the county of Banff, situated in a creek; 2 miles N. of Banff.

White Horse Vale, a vale of Berkshire, so called from the figure of a horse in a galloping posture, cut in the side of a chalky hill, as is supposed in memory of a great victory gained by Alfred over the Danes in the year 871. The curing the horse is an annual festival, and celebrated by rural games. On the top of the hill is a large Roman intrenchment, called Uffington castle, or Woolton castle. There is likewise another camp in the neighbourhood, with the burial place of the Danish chief, included by stones set on edge, a cromlech, and several barrows.

White Horses, cliffs on the south coast of Jamaica; 20 miles E.S.E. of Kingston.

White-Horse Bay, a bay on the west coast of the island of St. Christopher, a little to the north of Guana Point.

White Inlet, or Boca de Rationes, an inlet on the east coast of Florida. N. lat. 26°. W. long. 86° 20'.

White Island, an island in the South Pacific ocean, near the east coast of New Zealand, north of Cape Run-away, S. lat. 39° 31'. W. long. 182° 36'.—Also, a small island in the Atlantic, near the S.E. coast of Nova Scotia. N. lat. 44° 55'. W. long. 61° 56'.

White Island, or Burnt Island, a small island in the Arabian Gulf, near the coast of Adel. N. lat. 11° S. E. long. 64° 15'.

White, Isle of. See Isle of Wight.

White Keys River, a river of Africa, which runs into the Indian sea, S. lat. 30° 35'.

White Mountains, mountains of New Hampshire, peculiarly applied to the highest part of a ridge, which extends N.E. and S.W.: the whole circumference at least fifty miles. The height of these mountains above an adjacent meadow is reckoned, from observations made by the Rev. Mr. Cutler, of Ipswich, in 1784, to be about 5500 feet, and the meadow 3500 feet above the level of the sea. The snow and ice cover them nine or ten months in the year, during which time they exhibit a bright appearance from which they are denominated the White Mountains. From this summit, in clear weather, is exhibited a view extending sixty or seventy miles in every direction; although they are more than seventy miles within land, they are seen many leagues off at sea, and appear like an exceedingly bright cloud in the horizon. These immense heights, being copiously replenished with water, afford a variety of cascades. Three of the largest rivers in New England receive a great part of their waters from these mountains. Amanoquelle and Isral rivers, two principal branches of the Connecticut, fall from their western sides. Peabody river, a branch of the Amorificogen, falls from the north-east side, and almost
the whole of the Saco descends from the southern side.

The highest summit of these mountains is in about 44° N. lat.

White Oak Creek, a river of North Carolina, which runs into the Atlantic, N. lat. 34° 30'. W. long. 77° 26'.

White Oak Mountains, in the west part of North Carolina. N. lat. 36° 10'. W. long. 82° 30'.

White Point, a cape on the coast of Cape Breton, near Louisburg.—Allo, a cape on the fourth coast of Jamaica; 20 miles E. of Port Royal.—Allo, a cape on the north coast of the island of Cumbava. S. lat. 8° 15'. E. long. 118° 51'.

White River, a river of Louisiana, formerly thought to be a stream of inconsiderable magnitude, but now known to be one of the most considerable in the western country, and likely to become of still greater importance. It rises in the Black Mountains, which separate the waters of the Arkansas from those of the Mifouri and Mississippi. Several of its branches interlock with those of the Ohio river, the Maramek, and the St. Francis. It is navigable about 1200 miles, without any considerable interruption; 800 of which may be made with barges, and the rest with canoes or smaller boats. Its waters are clear and limpid, its current gentle, and even in the driest season, plentifully supplied from the numerous and excellent springs which are every where found. It also receives many considerable rivers in its course, the largest of which is Black river. The country which it waters is described by those who have traversed it as generally well wooded, and abounding in springs and rivulets: the soil is rich, though hilly; and it is said, that on the borders of this river a country may be chosen, at least 100 miles square, not surpassed by the best parts of Kentucky, and one of the best for settlements in the whole world. This river is situated on the S.W. side of the Mifouri, and is 300 miles wide at its mouth.

White River, a river of Guadalupe.—Allo, a river of America, which runs into the Connecticut, 4 miles south of Norwich.—Allo, a river of Jamaica, which runs into the sea, 4 miles W. of Montauk bay.—Allo, a river of Indiana, in the county of Kosciusko, which rises about N. Lat. 40° 45', and W. long. 85° 5'. and runs into the Wabash, N. Lat. 38° 15', and W. long. 88° 20'.—Allo, a river of America, which runs into Lake Michigan, N. Lat. 43° 40'. W. long. 85° 33'.—Allo, a river of Vermont, which runs into the Connecticut, N. Lat. 43° 38'. W. long. 72° 18'.

White Rock, a rocky illet in the East Indian sea, near the south coast of Java.

White Rocks, a range of buildings, accommodated for dwelling-houses, about a mile from Swansea, in the country of Glamorgan, situated on the river.

White's Bay, a bay on the coast of Newfoundland. N. lat. 50° 17'. W. long. 56° 13'.

Whitburn, a town in Scotland, in the country of Linlithgow; 21 miles W. of Edinburgh.

Whiteclay Creek, a hundred of Delaware, in New Castle county, with 1701 inhabitants.

Whitefield, George, in Biography, one of the founders of Methodism, (see Methodists,) was the son of an innkeeper at Gloucester, where he was born in 1714, and where he received the rudiments of literature, so as to be sufficiently qualified for his father's business, for which he was designed. Accordingly he commenced it as drawer at the Bell-inn. At school he is said to have been distinguished by a retentive memory and good elocution. Of his early years, he gives a very unfavourable account, so that there was nothing about him but a fitness to be damned, with occasional glimpses of grace that afforded some indication of his future destination. About the age of 18, he was admitted a servitor at Pembroke college, Oxford, and associated with those young persons whose dispositions and habits resembled his own, and whose conversation and manners contributed to cherish that religious enthusiasm to which he was strongly addicted. As soon as Dr. Benfon, bishop of Gloucester, received information concerning the state of his mind and the course of his general conduct, he made him an offer of ordination, when he was about 21 years of age, and he was accordingly ordained a deacon in 1735. Upon his return to Oxford, after preaching his first sermon at Gloucester, he took the degree of bachelor, and diligently employed himself in communicating instruction to the poor and the prisoners. During the two following years, he acquired a great degree of popularity by his public services in London, Bath, Bristol, and other places; collecting large auditories, and interlacing the attention of his hearers. His voice was strong and musical, his pronunciation clear and distinct, his imagination was lively, and his feelings were warm; and to these natural powers of eloquence we may add his dexterity of subjects, which were adapted to move the inconsiderate, and to comfort those that were awakened to a sense of their guilt and danger: so that we need not wonder that he should command a numerous audience. Upon receiving information that the province of Georgia was likely to open to him an extensive field of usefulness, he determined to visit it, and in May 1738, arrived at Savannah. Here he met with much greater success than his predecessor Wesley; and in order to supply the defect of education which he was concerned to observe in this province, he resolved to found an orphan-house, and in 1739 returned to England in order to collect money for this purpose. In England few of his clerical brethren were disposed to take much notice of him; nevertheless, his original patron, the bishop of Gloucester, gave him priest's orders: but upon afterwards visiting London, none of the churches into which he obtained admission were large enough to accommodate the crowds of people that assembled to hear him. It was about this time that he commenced his practice of preaching in the open fields, and the first scene of his exhibition in this way seems to have been Kingwood, near Bristol, where he collected thousands, chiefly of colliers, who without doubt derived benefit from his discourses. He also preached at Bristol in the open air, when he was refused access to the pulpits of the churches; and he likewise pursued the same practice in Moorfields and Kempton-common, near London, where, amidst the immense multitude that attended him, some persons occasionally treated him with rudenes, but the greater number were commanded by his peculiar power of address into respectful attention. Having succeeded beyond his expectations in soliciting contributions for his projected orphan-house in Georgia, he returned to America in August 1739; and in the following January laid the foundation of the building at Savannah. He then extended his tour as far as Boston, preaching to immense crowds, and collecting considerable sums for the completion of his design; and upon his return to Savannah he found his orphan family comfortably settled in their house; and in January 1741, he embarked for England. His absence had occasioned a declension among his followers; some other circumstances, besides the intermission of his personal labours amongst them, might probably have contributed to produce this effect. Whilf he was in America he had written, as he himself acknowledges, "two well-meant but injudicious letters against England's two great favourites, the Whole Duty of Man, and archbishop Tillottson, who, I said, knew no more of religion than Mahomet." His society had suffered from the influence of the Moravians. Mr. Wesley had
had preached and printed in favour of perfection and universal redemption, and against the doctrine of election. He had written a reply, but he acknowledges that he had used expressions that were too strong in reference to absolute reprobation, which had offended numbers of his spiritual children. His worldly circumstances were embarrassed, and he owed 1000l. for the orphan-house, and some of his bills were returned. He had some enemies who circulated reflections on his integrity in the conduct of his business; but they were never justified, and his state of secular affairs at his death affords a strong presumption that they were groundless.

Dr. Franklin, who lived upon the spot, bears testimony to his honesty. At this time, a separation had taken place between him and Wesley, and this had occasioned a decrease of his auditors. However, his zeal and perseverance overcame these difficulties. In order to counteract Wesley's popularity, he built a shed near his chapel in Moorfields, which he called the Tabernacle; and in process of time this rose from a mean beginning to be a spacious edifice; and he also renewed his field-preaching. At this time, he paid his first visit to Scotland; and though he was a clergyman of the church of England, which excused some prejudice against him, he was invited into the churches, and preached to large congregations, and made collections for his orphans.

On his return by Wales, he married a Mrs. James, a widow lady of Aberavenny. His zeal for doing good, and for making profelytes, induced him, in the spring of 1742, to engage in a contest with the idle people who had booths in Moorfields, and where they frequented for their amusements on holidays. On Whitsunday he collected a party of his attendants, and restored to the spot with a view of conducting a religious service. Although he was much disturbed in this effusion of his piety and zeal, the result, as he says, was so much in his favour, that he received 1000 notes from persons under conviction; and soon after more than 300 were admitted into the society in one day. In 1748 he returned from a second voyage to America; and then commenced his acquaintance with the countesses of Huntingdon, who appointed him her chaplain, and excited the curiosity of some persons of rank to hear him: among these were the earl of Cheltenham and lord Bolingbroke. About this period, it is said, his sentiments became more rational; for on his third visit to Scotland, it was announced to a synod assembled at Glasgow to investigate certain charges against his opinions, that with regard to certain points which were considered as objectionable, his sentiments had been altered for upwards of two years; and that he now seldom preached a sermon without guarding his hearers against impressions, and admonishing them that a holy life is the best evidence of a state of grace. From this time, he was fully employed by a visit to Ireland, two more voyages to America, and his English circuits, till the year 1756, when his chapel in Tottenham-court-road was erected. His labours were incessant for many years; but at length, on a seventh visit to America, he was seized with an athermic complaint at Newburyport, New England, which terminated his life in September 1779, near the completion of his fifty-sixth year.

With regard to his general character, we shall close this article with the reflections of a judicious and candid biographer. "That he had much enthusiasm and fanaticism in his composition is sufficiently evident from his own journal and letters; but whether these were accompanied, as they not unfrequently are, with craft and artifice, is a disputable point. There are, in his narratives, obvious marks of a disposition to represent himself as under the special protection of Providence, and to magnify trifling incidents into little less than miracles in his favour; and much of what is commonly called cant is apparent in his confessions and humiliations. Yet that he was a hypocrite acting a part will fearlessly be believed by any one who looks at his course of life during 34 years. He has been charged with dishonesty and immorality; yet as it is certain that he obtained the eleemos of many persons of worth, it may be concluded that such accusations were defitute of proof. His intellectual qualities were well suited to the talk he undertook; and in the pulpit he occasionally interspersed buffoonery with his veneration, the latter was not less effective on that account. His learning and literary talents were mean, and he is a writer only for his own feet." He published, at intervals, sermons, tracts, and letters, which, after his death, were collected in five vols. 8vo. Middleton's Life. Evangel. Moth. Eccl. Hist. Gen. Biog.

WHITEFIELD, in Geography, a town of America, in the district of Maine, and county of Lincoln, having 995 inhabitants.—Allo, a town of New Hampshire, in the county of Cowes, having 51 inhabitants.—Allo, a town of North Carolina; 40 miles W. of Newbern.

WHITEFIELD, or Wheatfield, a township of Pennsylvania; 156 miles W. of Philadelphia.

WHITEHALL, formerly called Skeneborough, a post-township of Washington county, in the state of New York, at the head of lake Champlain, about 65 miles N.E. from Albany: in mediad length about 10 miles from N. to S., and 7 wide; first erected in 1788, with its present limits. The soil is a tuff clay, and adapted to grass. Wood- creek and Pawlet river unite in this town, and afford facility to navigation and trade, as well as mill-fafts. Marble, limestone, and iron-ore, and also a mineral spring, are found in this township. It has 1 Congregational, 1 Presbyterian, 1 Baptist, and 1 Methodist congregation, and a competent number of common schools; 2 grist-mills, 2 saw-mills, a fulling-mill, and carding-machine.—Allo, an incorporated post-village at the N. end, with considerable trade, situated principally on the W. bank of Wood-creek, at its entrance into lake Champlain; 71 miles N.E. from Albany. About a quarter of a mile from the village is a handsome Presbyterian church, founded by the donation of John Williams, esq., of Salem, who endowed it with a parsonage of 60 acres of land. The whole population, by the census of 1810, was 2119, with 178 electors.—Allo, a township of Pennsylvania, in Northampton county, with 2551 inhabitants; 61 miles N. of Philadelphia.

WHITEHAVEN, a sea-port and market-town in Allerdale ward, in the county of Cumberland, England, is situated between two hills at the northern extremity of a narrow vale, at the distance of 40 miles S.W. from Carlisle, and 305 miles N.W. from London. The rife, progress, and increasing importance of this now rich and flourishing town, strikingly display the effects of trade, industry, and enterprise. From an obscure hamlet, it has advanced, within less than two centuries, to considerable magnitude and commercial importance; and, both in extent and population, far exceeds the capital of the country. In the year 1566, it consisted only of six fishermen's cabins; in 1633, of nine or ten thatched cottages; but in 1695, its buildings were sufficiently numerous for 2222 inhabitants, and have been progressively increasing; till, in the year 1818, the population was returned to parliament as 16,106, occupying 1940 houses. The increase of shipping has been proportionate: in 1685, the whole number of vessels belonging to this port was 46, carrying 1871 tons; they have since gradually increased to 230; the quantity of tonnage is nearly 74,000 tons. The honour of raising this town to its present importance must be attributed to the Lowther family.
family. Sir John Lowther, about the beginning of the reign of Charles II., purchased the lands of the dissolved monastery of St. Bees for his second son, Sir Christopher, who, as coal-owners that period came into general use, conceived the idea of improving his possessions by opening some collieries. No effectual progress was, however, made till after the Restoration, when another Sir John Lowther, who had succeeded to the estate, formed a plan for working the mines on a very extensive scale. To obviate all opposition to his operations, he procured a gift of all the ungranted lands within the district, and also of the whole sea-coast for two miles northward, between high and low water mark. He then directed his attention to the port, which was small and inconvenient; and, by his judicious schemes, laid the foundation of the present haven. Subsequent improvements have been made, particularly during the reign of George II., when an act was passed to perfect and keep it in repair, by a tonnage on shipping. The mines are said to be the deepest in England, and extend a considerable way under the sea: one has been carried 1000 yards out from the shore, at the depth of 112 fathoms under the water. Most of the coal exported from this haven is conveyed to Ireland; the quantity raised annually, on the average, is about 90,000 chaldrons. (See Coal.) The creek on which Whitehaven is built is so deeply seated, that the adjacent lands overlook it on every side. The approach from the north is singular, as the heights are so much above the town, that only the roofs of the houses can be seen till near the entrance, which, on this point, is through an archway of red free-stone. The town itself is one of the most respectable in the whole northern counties; the streets being regular and spacious, and crossing each other at right angles; the houses in general are well built, and even the tradesmen's shops exhibit a degree of elegance.

Here are three chapels, plain convenient structures: they were all erected by subscription of the inhabitants, aided by the benevolence of the Lowther family. St. Nicholas's chapel was built in 1693; Trinity, in 1715; St. James's, in 1752. The latter is neatly fitted up; the roof and galleries are supported by ranges of pillars. Besides the established chapels, here are three meeting-houses for Methodists, two for Presbyterians, and one for each of the following sects, Anabaptists, Roman Catholics, Glaflites, and Sandemanians. The principal manufactures are those of cordage and sail-cloth; the latter was only established in 1786, but already gives employment to several hundred workmen, though much of the business is executed by machinery of great power. A fair is held annually, and there are three weekly markets. The castle, as it is called, adjoining the east side of the town, one of the seats of the earl of Lonsdale, is a large quadrangular building, chiefly erected by the late earl, and containing some good paintings.

St. Bees, in which parish Whitehaven is situated, derives its origin from a religious house founded here by Bega, an Irish saint, about the year 650. On her death, a church was erected to her honour; but both these establishments having been destroyed by the Danes, they were replaced, in the reign of Henry I., by a new foundation for Benedictine monks. The church built at this period had the form of a cross, and great part of it yet remains. The east end is unroofed, and in ruins; the nave is fitted up as the parish church; and the cloisters is used as a burial-place. The whole is of red free-stone. In this village a free-school was founded by a bequest of archbishop Grindal, in the year 1587, under a charter of queen Elizabeth. The endowments were increased by James I., and have been since further augmented by various benefactions.—Beauties of England and Wales, vol. iii. Cumberland, by J. Britton and E. W. Brayley, 1802. Magna Britannia, Cumberland, by Meffrs. Lyfons, 4to. 1816.

WHITEHEAD, William, in Biography, an English poet, was born at Cambridge in 1714-5; educated at Wincleter school, where from his talent in writing verse he acquired the notice of Pope; and upon his return to Cambridge, obtained a scholarship of Clare-hall. As a poet, Whitehead's highest ambition was to resemble the manner of Pope; and of his proficiency he gave a specimen in his "Epistle on the Danger of Writing Verse," 1741. In the following year he was elected fellow of Clare-hall, and pursued his studies with a view to the church; but his poetical talents produced a change in his circumstances and in his purpose. Being recommended to the earl of Jersey as a proper tutor for his eldest son, he removed in 1745 to the earl's house in London, where his treatment was in the highest degree liberal. Having leisure for indulging his taste for literary pursuits, he turned his attention to dramatic composition, and produced a tragedy, entitled "The Roman Father," which was exhibited with applause upon the stage in Drury-lane in 1750. In 1754 he published another, the title of which was "Crepus," which was also favourably received. With the profits arising from these two performances he very honourably discharged the debts of his father, who had died insolvent. In this year he accompanied his pupil, vicount Villiers, and vicount Nuneham, son of Earl Harcourt, on their travels, which continued more than two years; and on his return he published an "Ode to the Tiber," and five elegiac epistles, which were much applauded. Lady Jersey, during his absence, had procured for him the appointment of secretary and regifter to the order of the Bath; and in 1757, on the death of Cibber, he succeeded to the laureat, which he rendered respectable; though in the discharge of the customary duties of the office, he did not escape abuse, and especially that of Churchill, whose popular satire almost overwhelmed the reputation of the laureat. Lady Jersey, in consideration of his services as governor to her son, invited him to take up his residence in her house, where he passed fourteen years, frequently visiting lord Harcourt, much respect ed by his noble host and his former pupils. He still amused himself by presenting to the public occasional productions, one of which was a comedy of the moral or sentimental class, entitled "The School for Lovers." After passing through life tranquilly and pleasantly, and maintaining an estimable character, he died suddenly, April 1785, in his 70th year. Of his works two volumes were published by himself, and to thee a third was added by Mr. Mason, who prefixed memoirs of his life and writings, to which we refer. Gen. Biog.

WHITEHEAD, George, an eminent person among the Quakers, was born in 1636 at Sunbiggs, in Welfmoreland. Attaching himself early in life to this society, and engaging in the propagation of its doctrine, he partook of the sufferings which, in that age, were the ordinary lot of its active members; and was once, simply for having preached at Nayland, in Suffolk, severely whipped by order of two justices as a vagabond; a proceeding which served, as might have been expected, to increase the disposition of the people to hear him. Soon after the Restoration of the monarchy, the Quakers were made the express subjects of a law, the precursor of others of like nature, which imposed on their profession and worship penalties extending to banishment. In the progress of the bill through the house of commons, Whitehead, with three other Quakers, was admitted to the bar of the house, and heard in defence of the society. They pleaded its cause with the freedom of conscious innocence,
cence, and the meekness of men prepared to suffer, but pleaded in vain:—the bill passed, and two out of the four, who had thus advocated the rights of conscience, presently fell victims to the force by which conscience was deliberately oppressed, dying in a crowded unhealthy prison, to which they were dragged from their peaceable religious meetings. Whitehead, who was imprisoned with them, survived to be liberated.

In the year 1672, when Charles II. issued his declaration for suspending the penal statutes against non-conformists, Whitehead solicited and obtained an order under the great seal for the discharge of about four hundred Quakers, many of whom had been for years under close confinement. He records, with expressions of satisfaction, the circumstance that some other diffident ones also partook at this time of the benefit of his exertions. On several other occasions he was concerned in applications on the Quakers' behalf to Charles II. and James II. And after the Revolution, when the Toleration Bill was before parliament, he was particularly serviceable to his friends in that matter; as likewise in taking a part in those representations, which procured the acceptance of their affirmation in lieu of an oath. A profession of faith being proposed for insertion in the above act, in terms which to the Quakers would not have been quite satisfactory, Whitehead and his coadjutors proposed the following, as their own belief on the points to which it relates, and which was adopted as a test for the society accordingly, viz. "I profess faith in God the Father, and in Jesus Christ his Eternal Son the true God, and in the Holy Spirit, one God, blessed for evermore; and do acknowledge the holy scriptures of the Old and New Testament to be given by divine inspiration."

Whitehead lived the greater part of his time in or near London, which accounts for his being one of those Quakers usually concerned in applications to the government. He was well esteemed by his brethren, whom he continued to edify by his ministry and example to the end, dying, after a short confinement, by infirmity, at the age of 86. Besides several writings chiefly controversial, he left some memoirs of his life, which were printed in one volume, 8vo, in 1725.

Whitehead, in Geography, an island in the Atlantic, near the coast of Maine. N. lat. 54° 46'. W. long. 4° 27'.—Also, a cape of Ireland, at the north-east of the bay of Carrickfergus, in the county of Antrim.

Whi...

WHITEKIRK, in Geography, a parish and village of Scotland, in the county of Haddington; 4 miles S. E. of North Berwick.

WHITELAND, West. See West White lord.

WHITEICK, a town of the flat of Kentucky; 13 miles S. of Stamford.

WHITELOCK, Bulstrode, in Biography, a lawyer and statesman, was born in London in the year 1605, and finished his education as a gentleman-commoner of St. John’s college, Oxford. Being destined for the profession of the law, he pursued the study of it under the direction of his father, Sir James Whitelock, who was one of the justices of the King’s Bench. As he had a taste for the fine arts, he was nominated as one of the chief managers of the royal masque presented by the inns of court to Charles I. and his queen in 1633, of which he has given a florid description. He became soon distinguished in his profession at the bar, and was frequently consulted by Hampden, when he was under prosecution for refuting the impostion of ship-money. In 1640 he was elected as a representative for Marlow in the Long parliament; and though his principles were favourable to the measures which then engaged the public attention, he concurred with Selden and others in depreciating a reformat to arms; but when the house had determined for war, he accepted the post of deputy-lieutenant for the counties of Oxford and Buckingham, and appeared at the head of a gallant company of horse raised among his neighbours. Nevertheless he was always averse from a civil contest; and in January 1642-3, he was one of the commissioners appointed to treat of peace with the king at Oxford; and in 1644 he was one of those who presented to the king propositions of peace agreed upon in parliament; and the king’s answer was, at his majesty’s request, drawn up by him and Holles, for which they were acceded of high treason by parliament, but extricated themselves with honour. As a member of the assembly at Westminster for settling the form of church government, he avowed himself in opposition to the divine right of presbytery. He also opposed the power of excommunication assumed by the Presbyterians; being always, like Selden, an enemy to violent exertions of church power by law and sword; and he was an invariable advocate of legal rights, and an opponent of arbitrary power, assumed or exercised in either house of parliament. When he became suspected by the parliamentary leaders, he joined the army-party, and opposed the measure of disbanded the troops, which was proposed by some of his former associates. When it was determined to bring the king to trial, he was nominated as one of the committee for drawing up the charge; but this was a business in which he did not choose to engage. However, he had no objection against taking an active part under the new government, and he was nominated in February 1648-9 one of the council of state. In some other instances he incurred the charge of inconsistency, as he complied with measures which he did not approve. To Cromwell he was so agreeable, that he was one of the four members of parliament appointed to meet him after his famous victory at Worcester in 1651. White lock avowed himself steadily attached to monarchy, as a part of the flat which could not be dispensed with, and as intertwined with the laws of the country, and he therefore suggested, that the late king’s eldest or second son should be sent for, and enter into terms for securing the liberties of the nation. Upon the dissolution of parliament by Cromwell, though he had previously refilled the attempts of the army to govern without the parliament, he obsequiously performed the functions of his office under the new establishment. The usurper, however, regarded him with distrust, and would not admit him into his first or little parliament. His commission of the seals was superseded by the supersession of the court of chancery; and he was therefore glad to be occupied in a station which would not require his interference in party contentions, which was that of ambassador from England to queen Christina of Sweden. Upon his departure, Cromwell assumed the title and authority of lord protector, and issued his instrument of government, which Mr. White lock had concurred in preparing, and which was afterwards found by Cromwell incompatible with his usurpation. Having concluded an advantageous treaty with queen Christina, who received him in November 1653 with distinction, he returned to his own country, and returned the office of commissioner of the great seal, upon the restoration of the court of chancery; and he was returned as a representative for three counties in Cromwell’s second parliament. Upon Cromwell’s regulation and limitation of the court of chancery, he again resigned the custody of the seal; and as some compensation for his loss, he was appointed a commissioner of the treasury. He was free and faithful in giving faithful advice to the Protector, and nevertheless retained his confidence. Declining the office of ambassador to Sweden, which was offered him, he acted as one of the commissioners to treat with the Swedish ambassador in England. He was returned for Buckinghamshire in Cromwell’s third parliament, and officiated for some time as speaker. Although he would not pretend to parliament the “Humble Petition and Advice,” which was intended to empower Cromwell to assume a higher title than that of Protector, he was chairman of the committee for conferring with him about it; and he concurred in the request that he would adopt the royal title. White lock contracted so decidedly in Cromwell’s interest, that he was one of those who were called by him to the upper house; but he declined being governor of Dunkirk, and also the honour of being created a viscount. During the short protectorate of Richard, White lock acted as one of the keepers of the great seal; and when the army set up a republican government, he was nominated one of the council of state; and as its president, he joined in all the measures that were adopted for upholding the tottering frame of government, on the principle that if no legal authority was acknowledged, the sword alone would probably govern. When Monk proposed to restore the remains of the Long parliament, White lock took a commission from the committee of safety for raising a regiment of horse, and urged Lambert to march against that leader. But the design failing, and the parliament meeting, he at first appeared in pursuance of the speaker’s summons; and as he had reason for supposing a design to apprehend him, he returned to a friend’s house in the country, and sent the great seal by his wife to the speaker,—and thus terminated his public life. Upon the Restoration, he had the good fortune to escape a bill of pains and penalties in the house of commons, only by the negative of a small majority. After having passed fifteen years in retirement, chiefly at Chilton-park in Wiltshire, he there died in January 1676; leaving a numerous family, after having been twice married.

Poculated of considerable abilities, and of distinguished talents for business, he would have claimed a more general and cordial respect, if he had not been a temporizer in his public conduct. His principles of government appear, however, to have been good, and in his temper he was above from every kind of violence and injustice. He was a well-wisher to the law and constitution, and supported them as far as it was consistent with his interest and safety.
private concerns he maintained an estimable character for probity and honour. After his death an anonymous editor, in 1682, published his "Memorials of the English Affairs;" or, an historical Account of what passed from the Beginning of the Reign of King Charles I. to King Charles II. his happy Restoration," vol. i., an improved edition of which appeared in 1733. From his MSS. was published in 1769, "Memorials of the English Affairs from the suppressed Expedition of Brute to this Island, to the End of the Reign of King James I," a chronological epitome of history for his own use. In 1766 Dr. Charles Morton, secretary to the Royal Society, published "Whitelock's Notes upon the King's Wrif forchoosing Members of Parliament, 15 Car. II. being Difpositions on the Government of England by King, Lords, and Commons," 2 vols. 4to. The same editor also published in 1774, "A Journal of the Swedifh Embaffy in the Years 1653 and 1654, from the Commonwealth of England, Scotland, and Ireland," written by the Ambassador the Lord Commiflioner White- 

The commiffioner, amid all his grave affairs, found leisure to cultivate music, of which he was very fond; and seems to have interfected himself in all the remarkable performances of his time. During the happy days of Charles I., mafters were so frequent at court and elsewhere, that in 1635 no less than five mafters were performed at different places before the king and queen. See Masque.

A very circumftantial account of one of these, "The Triumps of Peace," has been left to his family by the commiffioner himself, which was in the possession of the late Dr. Morton of the British Museum. The musical part of this performance seems to have been wholly affigned by the brethren at the Temple to commiffioner Whitelock. For in his narrative he fays, "I made choice of Mr. Symon Ives, an honofable and able muftician, of excellent skill in the art, and of Mr. Lawes, to compofe all the airs, leffons, and fongs for the maftice, and to be matters of all the mufticke under me." See Ives, and Lawes, William.

The commiffioner, besides being a performer, was a bit of a composer; as he fays with great triumph at the latter end of his narrative: "I was fo converfant with the musicians, and fo willing to gain their favour, especially at this time, that I compofed an aier myfelfe, with the affiftance of Mr. Ives, and called it 'Whitelock's Corante,' which being cried up, was fift played publiquely, by the Blackefryar's mufticke, who were then elegant the belt of common muftician in London. Whenever I came to that Houfe (as I did fometimes in thefe days), though not often, to fee a play, the mufticians would preferently play 'Whitelock's Corante'; and it was fo often called for, that they would have it played twice or thrice in an afternoon. The queen hearing it, would not be perfuaded that it was made by an Englishman, because she faid it was fuller of life and spirit than the English aiers ufe to be; but the nobility and the maker of it with her majeflyes roay tall commendation. It grew to that request, that all the common mufticians in this towne, and all over the kingdome, got the compofition of it, and played it publiquely in all places, for above thirtie years after." Among other moral reflections, addreffed to his family, on fuch vanities as he had been defcribing, lord commiffioner Whitelock adds: "Yet I am farre from difcommending the knowledge of this art (muftic), and exercife of this recreation for a diversion, and fo as you fpend not too much of your time in it, that I advise you in this as in other accomplishments, that you endeavour to get to fome per-fection, as I did, and it will be the more ornament and delight to you."

The lord commiffioner inferts his aier, in order to preserve it for the ufe of his family, if any of them should delight in it. This "Corante" may be seen in Burnet's Hist. Muf. vol. iii.; and the whole narrative of the maftice, entitled "The Triumph of Peace," from Whitelock's Labours remembered in the Annals of his Life, written for the Ufe of his Children," MS.

WHITEMARSH, in Geography, a townhip of Penn- 
ylvania, in the county of Montgomery, with 1328 in- 
babitants; 15 miles N.W. of Philadelphia.

WHITEN HEAD, a cape on the north coast of Scot- 
land. N. lat. 58° 37'. W. long. 4° 22'.

WHITENESS, a town of the ifland of Shetland; 
6 miles N.W. of Lerwick.

WHITENING of Bones, for a skeleton. See Bone.

WHITENING of Cloth. See BLEACHING.

WHITENING of Hair. See Hair.

WHITENING of Wax. See WAX.

WHITEMPAINE, in Geography, a town of Pennsyl- 
vania, in the county of Montgomery, with 955 inhabi- 
tants; 20 miles N.W. of Philadelphia.

WHITETOWN, the principal town and half fiire of the county of Oneida, in the state of New York, with 25,330 inhabi- 
tants; 30 miles from New York, and 140 S. of Albany. The whole area of this town is about 84 square miles; and its population, in 1810, was 603, with 68 electors, and 190 tax-able inhabitants. The village of White plains is pleasantly situated on a fine plain, three-quarters of a mile E. of Bronx creek, and contains a court-house, prison, and a handsome collection of houses. The American troops were defeated in this place, by the British under general Howe, in the year 1776.

WHITESAND BAY, a bay on the W. coast of Eng- 
lant, in the county of Cornwall, a little to the N. of the Land's End. N. lat. 5° 6'. W. long. 4° 34'.—Allo, a bay on the W. coast of Wales; 1 mile N.W. of St. 
David's.

WHITESTOWN, the principal town and half fiire of the county of Oneida, in the state of New York, situated on the Mohawk river, 95 miles N.W. of Albany; includ- ing Utica, and having three post-offices. Its form is irreg- ular, and area about 40 square miles. In January, 1785, Mr. Hugh White, from Connecticut, with a young family, became the first settler. In 1788 the town of German Flats was divided, and a new town erected, and named Whitestown, in honour of Mr. White. In 1798 the county of Oneida was establish- ed, by a subdivision of Kerkimer, and Whitestown included within this county. By subse- quent divisions, Whitestown was reduced to a mediate mea- sure of 9 miles by 8. It is situated immediately on the great thoroughfare between Albany and the Western lakes; between Canada and the principal commercial sea-ports of the American states on the Atlantic ocean. This town contains three large post-villages, Utica incorporated, 
Whiteborough, and New Hartford. Whitestown, includ- ing these villages, is unrivalled, in the United States, with regard to wealth, population, trade, and improvements, among inland towns of such recent settlement; and none in this state, of the same area, affords so great a population. It has seven principal churches; one Episcopal, three Pref- byterian, two Baptist, in one of which the service is per- formed
formed in the Welsh language, and one of Welsh Independents, besides some smaller houses dedicated to the same purpose. Here are three grammar-schools, one in each village, and many common schools. It has also a cotton manufactory. This town has been gradually enlarged and embellished. Its population, by the census of 1810, is 49,125, with 53,373 electors.

WHITTING, in Ichthyology, the English name of a common fish of the Aelurus kind, commonly distinguished by the writers in ichthyology by the name of Aelurus mollis, though by some called Aelurus albicollis and merlangus.

The winking, or gadus merlangus of Linnaeus; is a fish of an elegant form; the upper jaw is the longest; the eyes are large, the nose sharp, and the teeth of the upper jaw long,

Vol. XXXVIII.
WHITLOW, in Surgery, called also by surgeons paronychia, pararetum, onychia, &c. is an inflammation affecting one or more of the phalanges of the fingers, and generally terminating in an abscess. These are the parts which are the usual situation of the complaint; but sometimes a diseasae, which is precisely similar, makes its attack upon the toes. It is likewise to be understood, that in fever cases, the disorder extends itself to many other parts besides the finger, the matter making its way upward higher than the writh. Thus, as Callien judiciously observes, the skin, cellular substance, sheath of the flexor tendons, and less commonly that of the extensors, the tendons themselves, the annular and capular ligaments, the periosteum, the very texture of the bone-bones, and the pulpy substance underneath the nail, are all parts to which a whitlow may extend its mischievous consequences.

From what has been already observed, it must be plain that whitlows differ very much in their degree of violence, and in their depth and extent. Hence, surgical authors usually describe four or five varieties of the complaint. The division adopted by Callien comprehends five cases: namely, the cutaneous or superficial paronychia, the subcutaneous paronychia, the paronychia of the tendons, or theca, the paronychia of the periosteum, and the subungual paronychia, or that situated underneath the nail.

The cutaneous paronychia begins with a superficial inflammatory redness of the finger, and, as early as the second or third day from the commencement of the attack, the cuticle of the part affected becomes raised in the form of vesicles, which contain a limpid serum, but sometimes a bloody fluid. (Callien, vol. i. p. 294.) Mr. Pearson describes the cutaneous paronychia as being seated at the end of the finger, immediately below the cuticle, and as sometimes surrounding the finger and root of the nail. The skin, he says, is very little discoloured. The case speedily advances to suppuration; and when this process is completed, the cuticle appears almost transparent. After the contents of this little abscess are evacuated, the ulcer seldom demands any particular attention. Principles of Surgery, p. 88. edit. 2.

The subcutaneous paronychia makes its appearance in the form of an inflammatory tumour, attended with a great deal of acute pain. The symptoms, however, are not alarming, nor do they generally extend beyond the inflamed finger. In severe examples, the whole hand is more or less affected with pain and tension, and uneasiness is felt all up the arm. The severity of the pain, in such cases, frequently prevents sleep, and the whole system is thrown into some disorder. The attack of this kind of whitlow is attended with a more acute and throbbing pain than that of the cutaneous paronychia, suppuration proceeds more slowly, and matter is frequently formed under the nail. The diseasae is particularly situated in the cellular membrane under the cutis.

The more deeply-seated kinds of whitlow are those affecting the sheath of the flexor tendons and the periosteum, which parts, indeed, by reason of their vicinity to each other, are often both attacked together. The diseaasae commences with an intense, burning, throbbing pain in the finger, accompanied with severe febrile symptoms. At first, no swelling whatever can be perceived in the part affected; but afterwards a slight edematous tumour follows, which gradually assumes an inflammatory appearance, and the tumefaction spreads from the finger to the hand, and fore-arm, and even to the axilla. On the inner side of the arm, red hard furlings may also frequently be observed, which are inflamed aborative vesels tending to the axillary glands, which are themselves sometimes enlarged and very painful. The pain of the whitlow is particularly felt shooting up from the affected finger to the inner concdey of the humerus, and thence to the arm-pit. Delirium, and other alarming symptoms, occasionally attend these worst descriptions of whitlows, which are alleged to have proved sometimes fatal.

The matter, which is small in quantity, is either collected within the sheath of one of the tendons, or it is under the periosteum in contact with the bone, which is generally found in a carious state; and sometimes the superincumbent integuments suffer phscalation. See Pearson’s Principles, p. 90.

The subungual paronychia, or that which especially occurs under the nail, commences with inflammatory symptoms, which are, however, much less urgent and dangerous than those of the preceding case; and the situation of the disease renders its nature quite obvious.

The usual exciting causes of whitlows are various external injuries, as pricks, contusions, &c. The lodgement of a thorn or splinter in the part, is another frequent cause of these abscesses. They are, however, much more common in young healthy persons than in others; and they appear in many instances to occur spontaneously, that is to say, without our being able to assign any manifest cause for them. There is one particular sort of whitlow, which Mr. Pearson has thought proper to call veneral, as will be presently noticed.

With regard to the prognosis in ordinary examples of the complaint, it may be laid down that the cutaneous and subcutaneous paronychias are in general unattended with danger. But those whitlows which are formed within the theca of the flexor tendon, if they be not relieved by the timely interference of surgery, very often produce abscesses, extending up the hand and arm, in the course of the corresponding tendon and muscle, which parts become so altered and diseased, that their functions are permanently injured, and the bones of the finger destroyed by necrosis. When also the periosteum is affected, the matter lying underneath, or closely upon it, the neighbouring phalanx of the finger generally perishes. Whitlows beneath the nail frequently occasion a loss and separation of the part.

The indications in the treatment of whitlows are:

1. To endeavour to produce an early resolution of the inflammation; but as this attempt seldom succeeds, and the case almost proceeds to suppuration,

2. The
WHITLOW.

2. The great desideratum is to discharge the matter as soon after its formation as possible.

3. The last thing is to heal the wound.

With respect to the first indication, experience proves, that the inflammation, in a very early stage of the complaint, may sometimes be diffused by the adoption of ordinary antiphlogistic treatment. Here topical bleeding, especially the prompt and repeated application of leeches to the painful part several times in the day, is highly commendable; and the inflamed finger and hand may be covered with a cold, diffusible, fumifhing lotion, together with which some writers advise the whole limb to be bound with a circular roller. Others speak highly of the good effects of an early immersion of the affected finger in very warm water, or in lotions made of alcohol, vinegar, oil of turpentine, &c. and used as hot as can be borne. Callifian flates, that he has also frequently observed great benefit arise from the affusion of such lotions on the part. He even afferts, that the pain and more deeply-seated inflammation of the finger may be sometimes checked by applying caufive or a blifter to the integuments. When the patient's sufferings are very great, the exhibition of opium is indispensable after bleeding has been duly practifed. The fame writer alfo affirms, that electricity has been found ufed of the very commencement of a whitlow.

When two days elapse without any probability of resolution taking place, fuppuration ought to be promoted by the immediate and continued ufe of emollient poultices and fomentations. Nor fhoufl the surgeon wait for the abfeifes to point, but make an opening with lefs fots of time, in proportion as the cafe becomes worfe. In examples where the pain is exceedingly violent, the incision fhoufl not be deferred beyond the fourth day from the beginning of the pain. The opening ought alfo to be made at the part which was firft painful, and thence the cut should be continued longitudinally, and as deeply as the situation of the matter. The lancet, indeed, if requisite, must be introduced down to the bone, by which means a small quantity of deeply-seated confined matter may frequently be voided, and the pain and progres of the difafe at once fopped. Even when no matter is diffcharged from the opening, an early incision fometimes speedily relieves very severe cales of whitlow; probably (as Callifian obferves) on the principle of removing tension, and occafioning hemorrhage from the part. In thofe infances, in which an incifion has not been practifed in due time, and the matter under the tendinous theca has spread extensively up the hand and arm, it is fometimes neceflary to make the opening free and ample, without injuring, however, the annular ligament. The diffcharge of the abfeifes, and the evacuation of blood from the incifion, are followed by a moft immediate relief. When the matter is lodged under the periosteum, the bone is moftly found affected with necroflis. In cafes of this defcription, there are fome practitioners who prefer the removal of the difafeed phalanx, to awaiting a tedious and uncertain cure by the procefses of nature. Callifian, however, informs us, that he has often feen the dead portion of the bone expofed, leaving the reft in a state of prefervation.

When a whitlow under the nail cannot be diffcharged, the matter fhould be let out by an opening, practifed through the tranparent part of the nail, or by the fide of it. Some furgeons adopt the plan of scraping the nail, fo as to render it as thin as poifible, before they cut through it, which is an ingenious and commendable method. See Callifian's Syll. Chir. Hod. t. i. p. 293. 295.

In the fifth volume of the Medico-Chirurgical Tranfac-


tions, Mr. Wardrop has defcribed a very uiterate and troublesome species of whitlow, which, from its malignant character, he has called the onychia maligna. “The commencement of this difafe is marked by a degree of swelling, of a deep red colour, in the soft parts at the root of the nail. An oozing of a thin ichor afterwards takes place at the cleft, formed between the root of the nail and soft parts, and at laft the soft parts begin to ulcerate. The ulcer appears on the circular edge of the soft parts at the root of the nail; it is accompanied with a good deal of swelling, and the skin, particularly that adjacent to the ulcer, has a deep purple colour. The appearance of the ulcer is very unhealthy, the edges being thin and acute, and its surface covered with a dull yellow, or brown-coloured lymph, and attended with an ichorous and very fetid discharge. The growth of the nail is interrupted, it lofes its natural colour, and at some places appears to have but little connection with the soft parts. In this flate (says Mr. Wardrop), I have feen the difafe continue for several years, fo that the toe or finger became a deformed bulbous mass. The pain is sometimes very acute; but the difafe is more commonly indolent, and accompanied with little uneafinefis. This difafe affects both the toes and the fingers. I have only obferved it on the great toe, and more frequently on the thumb, than any of the fingers. It occurs, too, chiefly in young people; but I have alfo feen adults affected with it.”

With regard to the treatment of the species of whitlow named by Mr. Wardrop onychia maligna, all local applications have in many infances proved quite ineffectual, and the part been amputated. The only local treatment which Mr. Wardrop has ever fene relieve this complaint has been the evulcon of the nail, and afterwards the occafional application of efcharotics to the ulcerated surface. We have seen a fimilar plan occasionally Succede, and the applications which appeared to answer belt were, arlenical lotions, Plunket's caufsive, or a very strong folution of the nitrate of silver. Nothing, however, will avail till the nail is removed, and its total separation sometimes takes up a good deal of time, unless the patient submit to the great pain of having it cut away.

Mr. Wardrop tried with fucces the exhibition of mercury in four cafes of the onychia maligna. The medicine was given in small doses at firfl, and afterwards increafed, fo as to affect the gums in about twelve or fourteen days. The fores in general soon afumed a healing appearance when the fyltem was in this flate, and the bulbous swelling gradually difappeared. Wardrop in Medico-Chir. Tranf. vol. v. p. 135. &c.

Mr. Pearfon has published an accoumt of a peculiar fort of whitlow, to which he affixes the epithet venerelial. He obferves, that it generally appears in the form of a smooth, soft, unrefiting tumour, of a dark red colour, and is situated in the cellular membrane about the root of the nail. It is attended with an inconsiderable degree of pain in the incipient flate; but as fuppuration advances, the pain increafes in severity. The progres of the abfeifes to maturaflion is generally low, and is seldom completed.

When the matter is evacuated, the nail is generally found to be loofe, and a very foul but exquifitely fensible ulcer is expofed; and considerable foughs of cellular membrane, &c. come away, fo as to render the fore sometimes very deep. The difcoloured and tumid flate of the skin commonlyextends along the finger, confiderably beyond the margin of the ulcer. In fuch cafes, the integuments of the finger become remarkably thickened, and the cellular membrane is fo firmly
firmly condened, as not to permit the skin to glide over the subjacent parts. The bone is not usually found in a curious state.

According to the same author, this species of whitlow is more frequently seen among the lower classes of people, when they labor under lues venerea, than in the higher ranks of life. It does not appear to be connected with any particular state of the disease, nor is it confined to one sex more than the other. In the Lock Hospital, it is said to occur in the proportion of one patient in five hundred.

In adopting the name of venereal paronychia, Mr. Pearson informs us, that it is not with the design of implying that the cafe is a true venereal abces, the matter of which is capable of communicating lypalis to a found person. Its progress and cure, he observes, seem to be unconnected with the increased or diminished action of the venereal poison in the constitution, and to be also uninfluenced by the operation of mercury. Mr. Pearson considers the venereal disease as a remote cause, which gives occasion to the appearance of this as well as of several other diseases, which are widely different from its own specific nature.

In the incipient state of the venereal whitlow, when no severe symptoms are present, Mr. Pearson thinks it best to use no external applications, and merely cover the part with a bit of fine rag. The disease will then often gradually disappear of itself, without coming to suppuration. When matter is formed, Mr. Pearson says, the abcesses may be permitted to burst spontaneously. Every species of dreeving will frequently be found to give great pain, and disagree with the sore. The same writer, however, states, that one application, composed of equal parts of the bark of copaiva and tinctura thebaica, may sometimes be used with a good effect. The principal object is to keep the patient as easy as possible, by the internal use of opium, until the fluxes are separated, and the ulcer becomes clean. It may then be treated as a common sore; Peruvian bark will also be generally proper. In the thickened diseased state of the integuments, Mr. Pearson condemns amputation, as being likely to produce a tumor, which will change into a sore, resembling that for which the operation was performed. See Pearson's Principles of Surgery, edit. 2.

It is not at all clear to us, that Mr. Wardrop's case, which he terms the onychia maligna, is not actually the same disease as what Mr. Pearson has named the venereal whitlow. The only doubt arises from the former gentleman's recommending the exhibition of mercury as a means of cure; while the latter declares, that the complaint is quite uninfluenced by the operation of this medicine. We confess, that although some hundreds of cases of very bad whitlows have fallen under our observation, we have never met with any instance in which the cure seemed to require mercury.

Whitlow in the Feet of Sheep, in Rural Economy, a disease that takes place in the latter end of summer, and which is more frequent among the long than the short foot of sheep. It but seldom happens in clean sheep-walks, though it is very troublesome on soft, dirty, pasture-lands. It is frequently occasioned in the milking season, by the boughs or folds being dirty, and by the sheep being confined in the old houses. It is of the inflammatory nature, and commonly affects the fore-feet, but sometimes all four. The outer part of the hoof is the usual seat of the disease, and from the cleft a sharp fetid humour exudes, sometimes engendering maggots, and corroding the flesh, may even the bone. All around the hoof there is an inflammation, which turns black, and this part sometimes drops off. It is a very painful affection, so much so, that the animal often crawls.

As the weather gets more cold, it commonly becomes better, but it still walks in a lame manner.

On the appearance of the disease the foot is to be examined, and if diseased, the part opened to let out the acid matter. It is then to be washed well, and dried with mercurial ointment and sulphur in mixture, or tar with red precipitate, binding it up with a flannel bandage, to preserve it warm and clean. In case it does not take on suppuration, but degenerates into a foul and tedious ulcer, such applications as spirit of turpentine and sulphuric acid may be proper. And in all cases the sheep should be kept in a clean, easy, dry pature, until it becomes well. See Foot-Rot.

Whitlow-Grafts, or Mountain Knot-Grafts, in Botany. See Parasychia, or Illecebrum.

Whitlow-Grafts is also a name given to some species of draba.

Whitlow-Grafts, Rue-leaved, a species of saxifrage.

Whitstable, in Geography, a village and sea-port of England, in Kent, near the mouth of the Swale. Here is a considerable oyster-fishery, which employs upwards of 70 boats. Some colliers likewise bring hither coals for Canterbury and the neighbourhood; 7 miles N. of Canterbury. N. lat. 51° 22'. E. long. 1° 2'.

Whitson Island, an island in the South Pacific ocean, discovered by Captain Wallis on Whiton-eve, in the year 1767, about four miles long and three wide, surrounded by a reef. The boat's crew got some cocoa-nuts, and some fcury-graps: they met with none of the inhabitants, but some huts and several canoes building. No anchoring place for the ship could be discovered. S. lat. 19° 26'. W. long. 137° 56'.

Whitson, or Whitson Island, or Pentecost, one of the New Hebrides, in the South Pacific ocean, about thirty miles in length, and eight in breadth. S. lat. 15° 44'. E. long. 168° 20'. See New Hebrides.

Whitson Farthings. See Pentcostals.

Whitsunday's Passage, in Geography, a strait so called by captain Cook, from the day on which he sailed through it, in 1770; between Cumberland island and the coast of New Holland.

Whitsuntide, the fifteenth day after Easter.

The seaman properly called Pentecost, is popularly called Whitsuntide; some say, because in the primitive church, those who were newly baptized came to church between Easter and Pentecost, in white garments.

Whitsuntide Bay, in Geography, a bay on the north coast of the island of Kodiack, west of Cape Whittunday.

Whit-Tower, in Rural Economy, a provincial term applied to a collar-maker for team-horses.

Whittingham, in Geography, a town of Vermont, in the county of Windham, with 1248 inhabitants; 16 miles E. of Bennington.

Whittle, a provincial name applied to a sort of pocket or sheathed knife.

Whittlebury Forest, in Geography, a royal forest of England, in Northamptonshire.

Whittlesea Mere, a lake of England, in the county of Huntingdon, formed by a branch of the river Nen, situated to the S.E. of Peterborough.

Whittlesey, or Whittlesea, a town in the north part of the hundred of Witchford, Isle of Ely, and county of Cambridge, England, is situated on the confines of Northamptonshire and Lincolnshire, at the distance of 10 miles W.S.W. from the town of March, and 5 miles E. by N. from Peterborough. It contains two parishes, St. Mary's and St. Andrew's; but their boundaries cannot be distinctly
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distinctly ascertained, and they are so far consolidated, that, though in separate patronage, the two livings are generally held by the same person; and only one register of births and burials kept for both. Whittlesey formerly had a market; but when or by whom granted, there are no existing records. The market-day was Friday; but it has long been gradually falling into disuse, and since the year 1788 has been wholly discontinued. An annual fair for horses is still held. Each parish has a church, in which are various sepulchral memorials of ancient families. St. Andrew's church was given to the monks of Ely in the twelfth century, by Nigellus, second bishop of that see, for the purpose of augmenting their library: or, as it is expressed by an historian of that time, "making books for the library." At the well end of St. Mary's church is a very handsome tower, surmounted by a tall and elegant spire, which from its height constitutes a very conspicuous object from distant parts of this flat country. The tower is much ornamented with niches, pinnacles, and crocketts; and each angle of the octagonal spire, which connects with the angular pinnacles of the tower by flying buttresses, is adorned with foliated crocketts. There is in the town a charity-school for the instruction of twenty-six children, and several almshouses:

Whittlesey, exclusive of the town, is divided into five districts, named Ellry, Cotes, Eldernal, Willow-hall, and Glaismoor. At Eldernal was a chapel, consecrated in 1525, but long since dilapidated. At Glaismoor were found, in the year 1742, several Roman lamps made of the red ware. The population of the whole, in the return of the year 1811, is stated to be 4245, occupying 729 houses.


WHOLAGUNCE, a town of Hindostan, in Oude; 12 miles N.E. of Fyzabad.

WHOLDYACHUCK, a lake of North America. N. lat. 60° 20'. W. long. 109° 30'.

WHOLE, TOTUM, in Arithmetic, &c. See Part, Division, Partition, &c.

Whole, in Logic, is distinguished into four kinds; viz.

a metaphysical, when the essence of a thing is said to consist of two parts, the genus and the difference; mathematical or integral, when the several parts which go to make up the whole are really distinct from one another, and each of them may subsist apart; physical or essentinal, usually denoting and including the two essentiaI parts of man, body and soul, but more properly including all the essentiaI modes, attributes, or properties, contained in the comprehension of any idea; and logical, called also universal, the parts of which are all the particular ideas to which this universal nature extends. Watts's Logic, p. 117.

Whole Blood, Measure, Number, and Sine. See the Substantives.

Whole Milk-Cheese, in Rural Economy, a term used to signify such cheeses as are made from the whole meal of milk, in contradistinction to those which are made from a part of it only. It is observed in the Gloucester Report on Agriculture, that cowherd-cheese ought to be made of the whole meal of milk; but in a dairy of twenty cows, it is not unusual to let by a pan, of about seven or eight gallons, till the next milking, which is then skimmed, and added to the new meal, from which a similar quantity is taken as before. The cream thus laid by is made into milk-butter. Cowherd-cheeses are either thin, about eight to the hundred; or thick, generally called double Gloucester, about four to the hundred, or even larger. The latter are made in May, June, and July, principally, and even as long as grass continues good in some dairies.

It is noticed, too, in the farm book of report for the county of Peebles, in Scotland, that in the sheep-farms there, where sheep's-milk cheese is made, the whole of that fort of milk is seldom employed; but that the whole of the cow's milk upon the farm is mixed with the sheep's milk. That the butter, during this period, being ill-tasted, is kept for mixing with the tar for lining the sheep; and the milk is afterwards made into cheese. There are, in consequence, very few farms where cheese is made of entire sheep's milk; and that, from the various proportions of the admixture of cow's milk, there are few articles in commerce palling under one common denomination, of which the qualities are so various as those of sheep's-milk cheese. See DAIRYING, and CHEESE.

Whole-Moulding. The impropriety of continuing whole-moulding in the construction of ships, has been pointed out in the article SHIP-BUILDING; but as it is at present continued in the formation of boats; therefore, how far whole-moulding may be used in the construction of boats, we shall endeavour to explain by introducing a boat, which might be whole-moulded from the stem to the stern-post, if part of the midship-bow was approved of for the shape of the tranom; but as there can be no necessity that it should be so far whole-moulded, we shall omit it to the stern-post, but extend it quite forward to the stem.

The length, stem, and stern-post, being determined on in Plate Ship, fig. 1, the next thing is the station of the midship-frame, which is not of material consequence, only let it be before the middle of the boat. Then let off all the stations of the timbers afores and abaft the midship-bow.

The height in the midships being given, draw the shear-line, or top of the gunwale, so that it may have an agreeable appearance. The line below it shews the breadth of the sheer-rame, and the ticked line above it shews the upper edge of the wale-board.

The next thing is the rising-line, which requires some experience to determine at once, so as to answer every purpose; for not only the form of the midship-bow, but likewise the design of the boat must be kept in mind, to know how far we may venture to let the rising-line afores and abaft, without occasioning any hindrance to her flowage.

Having determined the height of the rising-line, dispose of the main height of breadth-line at the midship-bow, at such height as will befri the intended form of the midship-bow, and continue it from thence forward and aft, parallel to the rising-line; for so far as the boat is to be whole-moulded, the main height-of-breadth and rising-line must be parallel to each other in the direction of the square timbers.

In the half-breadth plan, fig. 2, square down from the sheer-plan, fig. 1, when the height-of-breadth line crosses the fore part of the rabat of the stem, and the aft part of the rabat of the stern-post, or aft-side of the tranom. But as this line rises above the tranom abaft, observe where the top of the side crosses the aft part of the tranom, and draw it parallel down from any of the stations of the timbers. Alto square down the station of the midship-bow.

Set off from the middle-line, A B, fig. 2, the half-thickness of the stem, and from thence sweep an arch to the thickness
Then place and faint 9, and move it till each letter on the lower edge of the mould agrees with the middle-line, and the mid-breath on the mould agrees with its corresponding height-of-breath line. Then draw the form of the mould from the head of the timber to the middle-line, as ticked in fig. 3, and draw a straight line from the side of the keel, at the upper edge of the rabbet, to touch the outside of the mould formed by the mould, except where the rabbet of the keel and item rises, as at F, G, H, I.

Set off the half-thickens of the keel from the middle-line, fig. 3, and take the height from the line A, B, fig. 1, to the lower edge of the rabbet at each timber, and fit it from the line A, B, fig. 3, on the line for the half-thickens of the keel or item; then with compasses set to the thickens of the bottom plank, sweep an arch; from the upper side of which draw a straight line to the back of each curve of the mould, which will finish completely the heets of the timbers.

The same method must be observed in the after-body towards perpendicular D, fig. 3, applying the midship-bend mould in the same manner as directed in the fore-body, making use of the mould as far aft as timber 12.

The after-square timber is 9; therefore, to 9 may be finished the heets of the timbers, by drawing a straight line from the back of the whole-moulding curve to the back of the sweep at the rabbet of the keel.

In whole-moulding, but few moulds are necessary to be made to mould all the timbers. Thus the floor-mould is to be made to the midship-bend in fig. 3, a little above the diagonal line, a b or c, which is to be the heads of the floors, and let the lower part of the mould correspond well with the rifting of the midship-bend, as is shown in fig. 4.

When the mould lies well, as in fig. 3, mark the middle-line on the lower edge of the mould, and the head of the floor on the outer edge. Make the inside of the mould to its proper scantling, and let the upper edge correspond well with the cutting-down of the inside of the midship-floors; which cutting-down is so marked in fig. 1.

Then in fig. 2, take the distance of each timber from the line C D to the main-half-breath line, and let them off on the lower edge of the mould, from the middle-line of the midship-bend towards the outer end of the mould, which is the middle-line for each floor.

Now fix the lower edge of the mould in fig. 3, on each rifting-height, in the same manner as the timbers were got in by whole-moulding; and when each mark on the mould is well with the middle-line, and on its proper rifting, describe on the outer edge of the mould the heads of the floors, or the diagonal line a b, or c.

Or, as in fig. 4, square the middle-lines of each timber, and then take the half-breaths of each floor from fig. 3; and let them off square from each middle-line in fig. 4, to intersect the edge of the mould.

The lower futtock-mould, fig. 5, is made to the rifting-height of the midship-bend, and from thence to the top of the floor, but need not be made so long at the heel as the floor-mould. The inside is made to the scantling, and the crof of the middle-line and the floor-head, on the lower futtock-mould, is done in the same manner as on the floor-mould; or the belt way is to lay the floor-mould on the lower futtock-mould, and crofs it by the floor-mould. When the lower futtock-mould is laid in its place to the midship-bend in fig. 3, then mark the main-breath on the mould, which is the main-breath for all the timbers. Then take the distance in fig. 1, from the main-breath line to the top of the floor at each timber, and let it off on the mould, from the main-breath.
breadth upward, which is the heads of all the timbers; and then the crossing of the lower futtock-mould is finished.

To cross the rising Square.—When the boat is whole-moulded, the floors and lower futtocks are generally moulded by the use of the rising-square; which is so called, because when the square is properly placed to mould any timber, one side of the square corresponds with the rising of that timber. When the timbers are moulded by the outside of the mould, and the heels by the rising-square, (which gives the upper edge of the rabate of the keel, or bearding-line,) then there is a button, called a cutting-down button, with the heights of all the floors, from the upper edge of the rabate of the keel to the cutting-down line; which gives the cutting-down or inside of all the floors.

To make the rising-square, let one side of the square be of sufficient breadth to receive the rising and the cutting-down, as may be seen by the square E.

When moulding the floors, or lower futtocks, the lower side of the mould is the rising of the timber; and consequently the edge of the square, which is to be applied to the under side of the mould, is also the same.

Then to mark or cross the square, take the distance from the rising-line in fig. 1 to the upper edge of the rabate of the keel, or bearding-line, at each timber; and set them off from that edge of the square, which is to be applied to the mould, on the other edge of the square, and close to the edge, drawing a margin to put the letters or figures under them. Then take the distance in fig. 1, from the rising-line to the cutting-down line, at the timbers, where the cutting-down is below the rising, and set them off from the edge of the square that is to be applied to the mould on the other edge of the square, but within the rabbet, as may be seen on the square. The other timbers, from A to B, where the cutting-down is above the rising, may be marked on the moulds.

From the edge of the square where the rabbets are placed, set off on the other edge of the square the half-thickness of the keel, which call the middle-line; and then the square is ready for moulding.

To mould the Floors.—The best way for moulding the floors for a whole-moulded boat, is to make two moulds, agreeable to the former directions, made and crossed both alike, but the sides revered. Then lay one on the other, the same as in fig. 4, keeping the lower edges in a straight line, and mooring them till the corresponding middle-lines on the moulds agree. The moulds in fig. 4, are fixed at 9, but the middle-lines on the lower mould cannot be seen; therefore, before the moulds are put together, it is best to mark (in chalk) on the edges of the mould the middle-lines of the timber. When the moulds are placed, fix the middle-line, marked on the edge of the square, to the middle-line on the mould of the timber, and the other edge of the square will represent the side of the keel.

Then apply a straight button to the rising of 9, on the edge of the square, and also to the outside of the floor-mould.

This will give the moulding of the outside of the floor, except timber 9, which is somewhat hollow. Then square the cutting-down for 9, across to the edge of the square, and draw a straight line to touch the inside of the mould.

In the same manner mould the other arm of the floor, by canting the square. But the rising and cutting-down should be marked on both sides.

Before the moulds are moved, mark the heads and firmarks, if any, as a guide to fix the lower futtock when put in its place, if it should not run down to the side of the keel.

To mould the lower Futtocks.—The lower futtock-mould is fig. 5, which is made in the same manner as the floor-mould, but continued as high as the top of the keel. The upper part being straight and perpendicular, and the mould made to the scantling, there is no difference between moulding one side of the floors and moulding the lower futtocks.

The same method of fixing the square for the moulding of the floors will serve to mould the lower futtocks, as on the square in the plate, where the middle-line on the square is put to the middle-line on the lower futtock-mould for G. A straight button applied to the rising for G, on the square, and to the back of the lower futtock-mould, gives the moulding of the outside of the lower futtock; and the cutting-down for G on the square brought to the edge of the square, a straight button from thence to the inside of the mould will also be the inside of the lower futtock.

Mark the firmark, or floor-head, in the same manner as the floors, in order to place the lower futtock to its proper height at the side of the floors, in case they should not be required to run down to the side of the keel.

Likewise mark the main-breadth, and the head for G, before the mould is moved.

That there is no difference between the floors and the lower futtocks in using the rising-square, may be seen more clearly in fig. 4, where the floor-mould is continued up to the top of the side, which makes the lower futtock-mould; so that the form of the lower futtock is seen, as well as the floor.

The two floor-moulds may be made to serve for all the floors, by putting the fore-body on one side of the mould, and the after-body on the other; but observe to cross one mould opposite to the other, so that when it is canted over, it shall then be proper to mould with.

Two rising-squares are sometimes used; one for the fore-body, and the other for the after-body, because the squares must be crossed alike on both sides, to mould the arms of the floors, and likewise to mould the lower futtock for both sides of the boat. Or, instead of this, the fore-body may be put on one side of the square, and the after-body on the other. When the square is wanted on the opposite side, chalk on the edge of the square the rising and the cutting-down for the timber to be moulded, and then cant the square.

Two lower futtock-moulds may also be made, or cross the fore-body on one side of the mould, and the after-body on the other. In order to mould a timber for that side of the ship where the firmarks are at the underside of the mould, chalk the firmarks for the timber wanted on the edge of the mould; or make two margins on the edge of the mould, serving one for the fore-body, and the other for the after-body, and revered on the opposite side.

The lower futtocks for boats generally run about half-way between the floor-head and the side of the keel; but if it were a hoy, or small vessel that was whole-moulded, the lower futtocks might then be required to run to the side of the keel, or dead-wood; wherefore, it is proper to show the moulding of them down to the side of the keel.

Various are the methods used by different artificers in moulding the lower futtocks; and it is evident that the method which has been practised most will appear the best.

Some will make no use of the square, but mark the heels of the lower futtocks on the mould, and provide a button, marked the same as the square; the lower end of the button being long enough to mould the outside of the foremoat and aftermold timbers; and the upper end of the button being long enough to mould the inside of the midship-timber.

Mark
Mark a firmark across the batton, supposed to represent the side of the square, which must always be fitted well to the lower edge of the mould; from which firmark, supposed to be the rising for all the timbers, set off close to the edge of the batton the heels of all the timbers in the fore-body, or the distance in fig. 1, from the rising-line to the upper edge of the rabiet of the keel, or beading-line.

Then draw a margin for the cutting-down of the timbers, and take the distance in fig. 1, from the rising-line of each timber to the cutting-down, and set them off on the batton for the cutting-down, as much above or below the firmark on the batton as the cutting-down is above or below the rising at each timber.

On the other side of the batton may be put the afterbody.

In some boats or vessels, where the rising and cutting-down are farther afield at the midship-bench, then the batton will be as useful as the square; but instead of the middle-lines being marked on the lower footlock-mould, it will be better to mark the side of the keel, or where the heels of the lower footlocks are intended to be, for the better applying the batton.

If the heels of the lower footlocks do not run down to the side of the keel, it will alter the risings on the batton; the heels being marked on the mould short of the side of the keel.

The proper heels of the lower footlocks should be marked on the mould, though moulded by the square; for then the edge of the square might be put to the proper mark on the mould for the heels of the timbers.

The middle-lines marked on the lower footlock-mould in the Plate, were intended only to show that the method of moulding the floors and lower footlocks were alike. The square is the beat to mould the floors, because the middle-lines are the properest to be marked on the floor-mould.

What has been said may suffice to shew that whole-moulding may, in some measure, be used, and yet form a pleasing draught, much more so than that of the boat in fig. 1, if less flowage were sufficient to answer the purpose for which she is designed.

WHOLESOE Ship, in the Sea Language, one that will try, haul, and ride well, without rolling or labouring in the sea. A long ship that draws much water may try, haul, and ride well; but if she draws little water, she may try and ride well, but never haul well; and a short ship that draws much water may haul well, but neither ride nor try well; and such is called an unwieldy ship.

WHORE. See CAmTESEAN, HARLOT, CONCUBINE, &c.

WHORL, in Botany. See VERITILLUS.

WHORLBAT, or HURLBAT, a kind of gauntlet, or leathern strap, laden with plumbers; used by the ancient Romans in their solemn games and exercices; and by them called cebus.

WHORLED PLANTS. See VERTICILATE.

WHORLES OF FLOWERS, among HERBALISTS, are rows of lesser flowers, set at certain distances about the main stalk or spike, as in penny-royal, &c.

WHORTLE-BERRY, BILBERRY, or CRANBERRY, in Botany. See Vaccinium.

The whortle-berry, with one flower upon each footstalk, oval-fawed leaves, which fall off in winter, and an angular stalk, called black subortis, or bilberries, grows very common upon large wild heaths, in many parts of England, but is never cultivated in gardens, it being with great difficulty transplanted; nor will it thrive long when moved thither. The fruit is gathered by the poor inhabitants of those villages which are situated in the neighbourhood of their growth, and carried to the market-towns. These are by some eaten with cream or milk; they are also put into tarts, and much esteemed by people in the North, but they are seldom brought to London.

The shrub on which these grow rises about two feet high, having many branches, which are garnished with oblong leaves, shaped like those of the box-tree, but somewhat longer, and a little fawed on their edges. The flowers are shaped like those of the arbutus, or strawberry-tree, of a greenish-white colour, changing to a dark red toward the top. The fruit is about the size of large juniper-berries, and of a deep purple colour, having a juice upon it when untouched, like the blue plums, which is rubbed off with handling.

The whortle-berry with nodding bunches of flowers terminating the branches, and oval leaves which are entire, turned back and punctured on their under side, called visisidea, and red subortis, is an ever-green shrub, seldom rising above fix or eight inches high, with leaves like those of the dwarf-box, which grows upon moors in several parts of the North, but is not capable of being easily transplanted: the berries are red, and have a more agreeable acid flavour than those of the first fort.

The whortle-berries with oval, entire, refracted leaves, and naked, slender, creeping stalks, called moss-berries, moor-berries, and cran-berries, produce branches small as thread, and trailing upon the mossy bogs, which are garnished with leaves resembling those of thyme, with the upper surface of a shining green, and white underneath. The berries, which grow upon long slender foot-stalks, succeeding the flowers, are round, red, and spotted, of a sharp acid flavour, and much esteemed for tarts, or eaten with milk or cream. This is a native of bogs, and cannot be propagated upon dry land.

There are several other species of this genus, some of which are natives of Spain and Portugal, others of Germany and Hungary, and several of the northern parts of America; from whence those large fruits are brought to England which are used by the pastry-cooks of London, during the winter season, for tarts. But as all these sorts grow naturally in swamps and bogs, they are not easily transplanted into gardens in their native country, so as to thrive or produce fruit; therefore, there can be little hope of cultivating them to advantage. Miller.

WHORTLE-BERRY, African, a species of ROYENA.

WHORTLE-BERRY, Bear’s. See UVA Ulf. WHY, in Falconry, denotes the fluttering of partridges or pheasants as they rise.

WHY-TEA, in Geography, a bay on the east coast of Owbyhee. N. lat. 19° 44'. E. long, 204° 54'.

WHY-MEA BAY, a bay on the north coast of the island of Wunoo. N. lat. 21° 38'. E. long, 204° 51'.

WHY-MEA Road, a road on the south-west coast of the island of Attowas. Captain Vancouver says, this bay is much confined in respect to safe anchorage.

WHYTE, Robert, in Biography, an excellent composer of church-services in the style of Palestrina, which, however, he could not imitate, as he was anterior to him, and a great matter of harmony before the productions of this chief of the Roman school were published, or at least circulated, in other parts of Europe. Whyte was dead in 1581, when his Latin Full Anthems and Services were beautifully transcribed in a set of books, still preferred at Oxford;
WHY

Oxford; as we find by a dithach at the end of a prayer, in five parts, upon a plain song: "Pecucum Sanete Domine."

Maxima omnium nostrorum gloria Whyte
Tu peris; æternum fed tua muta manet.

Whyte preceded Tallis and Bird, and died before their fame was well established. His works seem never to have been printed; but in the library of Christ-church, Oxford, a sufficient number of them has been preferred in the Aldrich collection, to excite not only wonder, but indignation, at the little notice that has been taken of them by musical writers. Morley, indeed, has given him a place in the list of compofer at the end of his Introduction, and ranks him, with Orlando di Lasso, among excellent men, who had ventured to begin a composition with a fourth and sixth; he likewise places him with Fairfax, Taverner, Shepherd, Munday, Parsons, and Bird, "famous Englishmen who have been nothing inferior to the best composers on the continent."

And no musician has then appeared who better defiied to be celebrated for knowledge of harmony, and clearness of style, than Robert Whyte, as is manifested in Burney's Hist. of Mu$. vol. iii. by an anthem for five voices.

But besides this matterly composition, and a great number of others, to Latin words, which we scorcd from the Christ-church books, and which were probably produced at the latter end of Henry VIII.'s reign, or during the time of Queen Mary, when the Romish religion was still in use, we are in possession of a small MS., which, by the writing and orthography, seems of the 16th century, entitled "Mr. Robert Whyte, his Bits, or Three Part Songs, in Partition: with Ditties, 11; without Ditties, 16."

These are short fugues or intonations in most of the eight ecclesiastical modes, in which the harmony is extremely pure, and the answer to each subject of fugue brought in with great science and regularity. Burney.

WHYTHORNE, Thomas, gentleman, in Musical History, author of a book of songs, printed by John Daye, in March 1574, under the following title: "Songes of three, fouer, and five voyces, composed and made by Thomas Whythorne, gentleman, the which songes be of fundrie fortes, that is to say, fome long, fome short, fome hard, fome easie to be fonge, and fome between both; alfo fome folome, and fome pleafant or mery; fo that according to the fkel of the fingers (not being mutifians), and difpoftion or delicte of the heares, they may heare fuch songes to their contentation and liking."

Our secular vocal music, during the first years of Elizabeth's reign, seems to have been much inferior to that of the church, if any judgment can be fairly formed of it from this book, published before the fongs of Bird had appeared, and of which both the words and the music are alike truly barbarous. But we have, in our own time, music-books published in England every day without genius or science to recommend them. And it is not certain that Whythorne's fongs were ever in much public favour. Now, if it should happen that one of these, by escaping the brolm of Time, should reach posterity, and fall into the hands of some future antiquary, critic, or historian, who should condemn all the compositions of the present age by one, that had, perhaps, been never performed or heard of by contemporary judges and lovers of good music, the sentence would very unjustly.

WHYTT, Robert, F.R.S. in Biography, a distinguished physician, was born at Edinburgh in 1714. Educated at St. Andrew's, and studied physic first at Edinburgh, and afterwards at London, Paris, and Leyden. He settled in his pro-

WIB

feftion at Edinburgh, where he became a fellow, then president of the college of physicians, and in 1746 chairman of the institutions of medicine in the university. As a medical practitioner and teacher, and also as a writer, he acquired celebrity. The first of his publications was an "Essay on the Vital and other Involuntary Motions of Animals," 1751, in which he advances a theory different from that of Stahl, as he attributes these motions not to the soul, acting to a foreseen end, but to the power of Julius. In 1755 he published "Physiological Essays, containing an Inquiry into the Causes which promote the Circulation of the Fluids in the very small Vessels of Animals; with Observations on the Sensitive and Irritability of the Parts of Man and other Animals." Here he supposes that the action of the heart is not sufficient to propel the blood through the minute vessels, but that it is assisted by an oscillatory motion of the vessels themselves. Of this work, an enlarged edition appeared in 1761. His other works are, "An Essay on the Virtues of Lime-water in the Cure of the Stone," 1752; "Observations on the Nature, Cause, and Cure of those Disorders which are commonly called Nervous, Hypochondriac, and Hysterical," 1754; and some papers in the Edinburgh "Essays and Observations, Physical and Literary." A posthumous work appeared, entitled "Observations on the Dropsy of the Brain." Having long laboured under a complication of chronic complaints, he died in 1766. His son published an edition of all his works in 1768, 4to, under the inscription of Sir John Pringle. Haller Bib. Anat. Gen. Biog.

WIA, in Geography, one of the small western islands of Scotland, a little to the south of Benbecula. N. lat. 57° 22'. W. long. 7° 11'.—Also, one of the small Western islands, near the east coast of Barray. N. lat. 56° 58'. W. long. 7° 22'.—Also, a small island near the west coast of Skye. N. lat. 57° 21'. W. long. 6° 27'.

WIAMPA, or WINTA, or Sunpa, a town of Africa, on the Gold Coast, in the district of Agonna.

WIANDOTS. See WYANDOTS.

WIAPOCO, or LITTLE WIA, one of the navigable mouths of the Oronoko.

WIBALDUS, in Biography, a person of note in the 12th century, descended from a noble family in the bishopric of Liege, completed his studies at Liege, and became a teacher at Vaffo, and afterwards at Stablo. In 1130 he was elected abbot; and in 1136 he accompanied the emperor Lotharius on his expedition to Italy, by whom he was employed in several important departments, and fixed as abbot in the monastery of mount Caffino. But he quitted this monastery in the following year, and returned to Germany. In 1146 he became abbot of the monastery of Corvei on the Wafer, in which he was confirmed by king Conrad, to whom he was no less an object of confidence than he had been to Lotharius. He was no less a favourite with Frederic I., who had sent him twice as ambassador to Conflantinople; but on his return from his last mission thither, he terminated his life at Bulelia, in Paphlagonia, in consequence, as it is said, of poison, which had been given to him in the month of July, 1158. His Letters, mixed with some other works, one volume of which only remains, throw considerable light on the state of society at that time, and on the ecclesiastical history of Germany. Gen. Biog.

WIBLINGEN, in Geography, a town of Bavaria, with a Benedictine abbey, near the conflux of the Iler with the Danube; 3 miles S.S.W. of Ulm.

WIBORGIA, in Botany. See WIBORIA.
WICBURG, in Geography. See Viborg.

WIBY, a town of Sweden, in the province of Norcia; 18 miles S.W. of Oreb.ro.

WIC, denotes a place on the sea-shore, or on the bank of a river. Though in the original Saxon, it more properly signifies a street, village, or dwelling-place; as also a caftle. See Wyke.

We often meet with wic in the Saxron writers, as a termination of the name of a town which had a complete name without it: as, Londen-wic, that is, London-town; which signifies no more than London. In the Saxon Annals, it is mentioned, that king Ethelbert made Meltius bishop of Lunden-wic. So, Ipswich is written in some old charters, vill de Gippo, and sometimes villa de Gippo wic: which is no variation, but the same thing; for Gippo is the complete name, and the Gipp-wic is Gipps-town.

WICCAKAW, in Geography, a town of the Flate of Georgia; 22 miles N.N.W. of Oakfuksee.

WICHCRA, a river of Saxony, which rises three miles N. of Waldenburg, and runs into the Pleifs, 2 miles N. of Borna.

WICHTIS, a town of Sweden, in the province of Nyland; 27 miles N.N.W. of Helffors.

WICHTRACH, a town of Switzerland, in the canton of Berne; 12 miles S.S.E. of Berne.

WICK, a royal borough, market-town, and the county-town of the shire of Caithness, Scotland, is situated at the entrance of the small river Wick, the effuary of which forms a good harbour, at the distance of 279 miles N. from Edinburgh. The town is small, and the streets narrow and confined; but there are several respectable buildings to ornament the place. The church is an old, dark, and ill-contructed edifice. A weekly market is held on Fridays, and is well supplied. The chief sources of commerce and industry are the fisheries, which are prosecuted with great attention and success. The town and borough-lands of Wick were anciently part of the earldom of Caithness; on the petition of George, then earl, a charter was granted by James VI. of Scotland, Sept. 24, 1589, erecting the town of Wick into a royal borough, under the superiority of that nobleman. In 1672 the whole earldom of Caithness was disposed of to John Campbell, afterwards created earl Breadalbane, by whose successors it was sold to the family of Sinclair, in whom the superiority is still vested. In 1716 the convention of royal boroughs fixed the fett or government of the borough of Wick. By this fett, the old magistrates nominate two persons, out of whom a provost and two bailies are to be chosen by the free burgesses: the provost and two bailies so elected have the right of choosing seven counsellors, a treasurer, and a dean of guild. Wick, in conjunction with the boroughs of Dingwall, Dornock, Kirkwall, and Tain, sends one member to parliament. The parish of Wick is twenty miles long and ten broad; and in the population report of the year 1811 is stated to contain 5980 inhabitants. Carlisle's Topographical Dictionary of Scotland, 4to. 2 vols. 1813. Gazetteer of Scotland, 1806. Beauties of Scotland, vol. v. Caithnessshire.

WICK, a river of Scotland, which runs into the Northern ocean, at Wick, in the county of Caithness.

WICHER, a twig of the osier shrub, fingle or wortich. WICHER-Basket, in Rural Economy, any sort of basket which is made of wicker-work, or the plaited or twisted twigs of the willow, or other such kinds of young shoots. See Basket.

A sort of wicker-basket or braid, too, is made use of in grafting in field, orchard, or fruit grounds. It is observed in the Gloucestershire Report on Agriculture, that the grafts are secured immediately after the compot is put on, with "braid." These are open wicker-baskets in the form of an inverted cone, fitting the stock below the place to which the compot extends, and rising about two feet high, and expanding at the top to nearly the same diameter. This contrivance serves not only to guard the grafts in their early state, but also to keep the shoots to a proper compact form of growth. The practice chiefly prevails on the banks of the Severn, where the oifer (falix viminalis) is grown in great abundance.

In hop-gounds likewise large wicker-baskets are employed for picking the hops into. See Hor.

And wicker-work of the basket kind is made use of for many other purposes of different forts.

WICHER-Tree, a name given by the English to a tree common in China, and described by Kircher and others. It is, as it were, a rope twisted by nature, about an inch thick, and creeps along the earth often for above a hundred paces together, much embarrassing the way, but serving for cables of ships, seats, hurdles, beds, mats, and various other necessary uses. It endures no vermin, and is much valued for being cool and refreshing in the hot seasons.

WICHER-Work, in Agriculture, a sort of basket-work on a large scale, used for defending land from water of the sea or other kinds. It is observed by Mr. Loudon, in his work on "Country Residences," that in some very sandy shores, defences of the embankment kind may be made of wicker-work; and that three or four rows of paling may be made of different heights, and the intervals between them be filled with wicker, brushto, straw, or any other such materials. It is thought that these materials would retain the sand as the tide palled through among them; and that in a very short time a defence or fort of embankment would be formed of the shelving kind, which should then be planted with the upright sea-grafts, in order to bind it. See Embankment, and Water, Sea, Defending Land from Allo Upright Sea Lyme-Grafs, and Elymus Arenarius.

WICHERAD, in Geography, a town of France, in the department of the Marne. It gave name to a lordship, surrounded by the duchy of Juliers; 3 miles N.E. of Erkeleens.

WICKEI', of the French guiche, a little door within a gate; or a hole in a door, through which to view what passes without.

WICKFORD, in Geography, a town of Rhode Island, with a post-office; 10 miles N.W. of Newport.

WICKHAM, commonly called Market-Wickham, to distingiuish it from two other places of the same name in the county, is a village and parish in the hundred of Wilford, and county of Suffolk, England. It has been a place of much greater confluence than it is at present, and had a weekly market and town-hall, where the quarter-seissions were held. The spiritual courts for the archdeaconry of Suffolk are still held here. The parish-church, being built on a hill, constitutes a land-mark for vessels failing by the coast. From the tower, a specktator may see fifty other churches. An aisle, or chapel, on the south side of the church, was built by Walter Fulburn, of this parish, who died, and was buried within its walls, in 1489. The rectories of Wickham, Pettitfree, and Bing, all in the hundred of Wilford, were bequeathed in 1718 by Mr. John Pemberton for charitable uses. According to the population report of 1811, this parish contained 133 houses, and 906 inhabitants. It is 12½ miles N.E. of Ipswich, and
and 81 in the same direction from London. The market, which was formerly held on Saturdays, has long been discontinued.—Beauties of England and Wales, vol. xiv. Suffolk, by F. Shoebler.

WICKHAM Breaux, and WICKHAM Strzyth, the names of two other parishes in Suffolk, England.

WICKLIFISTS, or Wickliffites, in Ecclesiastical History, a religious sect, who had their rise in England in the 14th century, and their name from their leader John Wickhife.

Wickhife, of whose opinions we give some account in his biographical article, (see Wickhiff,) denied that bishops were of a different order from priests, and that by virtue of their office they had any power to do what priests have not; and that in the apostolic times the two orders subsisting in the church were those of priest and deacon. With regard to tithes, he observes, that we do not read in the Gospel where Christ paid tithes, or commanded any man so to do; and that if they were due by God's commandment, there should be every where in Christendom one manner of tithing; and that those things which are due to priests should be given freely, without exaction or constrain ing. In opposition to the papal claims of supremercy and dominion, he maintained that the grants of emperors may be refused; that St. Peter and his successors have no rights conferred upon them of civil or political dominion; that the persons of the clergy and the goods of the church are not exempted from the civil powers; and that bulls of abolution or excommunication are conditional and not absolute, and depend for their effects on the disposition and character of those to whom they pertain.

Wickhife defines hereby to be error maintained against holy writ, and that in life and conversation, as well as in opinion. He ventured to affirm, that children who die without baptism may be saved; that this rite does not confer grace, but only signify that which was before given; and he denied that all sins are abolished by baptism. But in these and some other points, occurring in his various works, which were published at different times, he is not always perfectly consistent; but in all matters of principal importance he is uniform.

He left many followers in England and other countries, who were called Wickliffites and Lollards, and who held their opinions in private without making any public profession of them; though they were generally known by their disparaging the superfluous clergy, whose corruptions were so notorious, and their cruelty so enraged, that it was no wonder the people were much prejudiced against them. Wherever they could be found, they were terribly persecuted by the inquisitors, and other instruments of papal vengeance.—Lewis's History, &c. 8vo. paffim. Moll. Eccles. Hist. vol. iii. 8vo. Burnet's Hist. Reform. vol. i. p. 23.

WICKLOW, in Geography, a maritime county of Ireland, on the east coast, having the county of Dublin on the north, the Irish sea on the east, the counties of Kildare, Dublin, and Carlow, on the west, and that of Wexford on the south. Its extent from north to south is 32 Irish (403 English) miles; from east to west, 26 Irish (33 English) miles; and the superficial contents are 311,600 acres, or 486 square miles, equal to 500,000 acres, or 780 square miles English. Mr. Radcliffe, according to the county map, states the superficial contents at 305,404 Irish acres. There are 58 parishes, which have 20 churches, mostly in the archiepiscopate of Dublin. Dr. Beaufort states the population at 58,000. "A great part of Wicklow is rendered unfit for habitation, and incapable of culture, by mountains intermixed with rocks and bogs. Howe ver, though the heart of the county be a cheerless waste, the hills on the east and west sides, and especially along the coast, are from six to eight miles in breadth, being many of them well wooded, and intermixed with profitable and rolling valleys, form a delightful and various scenery. They are crowded with gentlemen's seats, and are not without small towns and villages." This was Dr. Beaufort's account in 1792. In 1801, captain Frazer published a statistical account for the Dublin Society. This gentleman laments, that "the Wicklow farmers foul the land by repeated corn-crops, and seldom or never lay it down to grass with feeds." He deplores "the total neglect of the improvement of the breed of animals for rock and labour;" and under the head of ploughs he remarks, "the common plough in use in this district is the swing-plough; it is seldom, however, formed on any scientific principles, and is generally very clumsy, and ill-adapted for making clean or regular work." In 1812, however, when the Rev. Thomas Radcliffe published a Report of the Agriculture and Live-Stock of the County of Wicklow, a very great change had taken place. A few extracts from this interesting publication will furnish the reader with the most authentic information on the state of this county, and of what has been effected by the exertions of the Farming Society of Ireland, its own local Farming Society, and the encouragement as well as example of good landlords.

The climate of the county is, in general, mild; but on the easterm side, along the sea-coast, is peculiarly warm, and favourable to vegetation; infomuch that there is almost a perpetual spring; and land of an apparently light quality is known to produce crops equal, if not superior, to those on the richest soils in other parts of Ireland. The crops commonly cultivated are, potatoes, wheat, barley, and oats. With respect to potatoes, the valuable system of drilling is almost universally adopted. The quantity of wheat is inconsiderable: it is generally taken after the potato-crop, sometimes after another white crop, or upon the lea; but the periodical fallow for wheat is fortunately unheard of. The barley-crop is taken after potatoes or turnips, and, like the wheat, is sown under the plough. The oat-crop, by the common practice, is taken upon the lea; but if upon stubble-ground, it is sown under the plough. The crops are not exceeded in quantity or quality in any part of Ireland. Green crops are not in much use among the tenantry. The manure in this county, besides dung, consists of brown, blue, and white marl, lime and lime-flour gravel. In the greatest part of this county, the implements of the bolt construction are in very general use; such as the Scotch plough, as recommended and supplied by the Farming Society, the Scotch harrow, the Scotch cart, drill-machines, and even the threshing-machine. Molt of the improved breeds of cattle have been introduced into this county; but Wicklow cannot be considered as a breeding county. The dairies are numerous; but, on a contracted scale, averaging from eight to fifteen cows, and almost uniformly engaged in the feeding of veal for the Dublin market. In the northern part of the county, much of the milk is consumed in fattening early lamb. The county of Wicklow,though not to be classed as a breeding county with respect to cattle, is very extensively so with respect to sheep, its vall tracts of mountain supplying a wholesome, though not an exuberant, pasturé to that animal. The breed of this county is the mountain kind; and the number of breeding ewes may be stated at 20,000. The South Down are the favourites with the gentlemen; and many flocks of the native mountain have been crossed with South Down. The Merino sheep have also been successfully introduced. The
cotton manufacture is carried on with spirit at Stratford-upon-Slaney. The woollen manufacture is chiefly limited to the flannel-trade. This, however, is carried on largely, and is a source of fair profit and industrious occupation. It prevails on the property of earl Fitzwilliam, and the Flannel-hall at Rathdrum was built at his lordship’s expense. The average annual sale is about 5000 pieces of 120 yards each.

The romantic beauties of this county have been often described. The vicinity to Dublin makes them easily accessible, and few travellers omit to visit them. The antiquities of Glendalough have been noticed in the proper place, under that name. The mineralogy of Wicklow has been noticed in Dr. Fenton’s valuable Notes on the Mineralogy of the Neighbourhood of Dublin; and on this head Mr. Griffith’s Report on the Mountain District of Wicklow should also be consulted. This uncultivated district has many peculiarities, which confit chiefly in the facility of access by means of roads; the vicinity of highly improved lands and industrious inhabitants; the frequent occurrence of beds of lime-Rome, gravel, and marl; the belt manure for the amelioration of mountain soils; and the uncommon mildness of the climate. These uncultivated lands occupy about 200,000 Irish acres, of which about 60,000 consist of black bog; the remainder is moory soil, generally covered by coarse ledgy grays, or grays intermixed with heath. In this district, many rivers have their sources. The Liffey, with its tributary streams, takes a circular course through the county of Kildare, and falls into the bay of Dublin; the Slaney runs southward to the county of Wicklow; the Fartry demibogens itself at Wicklow; and the Ovoca at Arklow. (For an account of the Cronbane mines, see CRONBANE.) At Croghan Kinthela, in the southern part of the county, a quantity of native gold has been extracted by washing from the alluvial soil, of which an account, by Meffrs. Mills and Weaver, may be found in the Tranactions of the Dublin Society. Near 600 ounces of gold, worth above 2000l., were extracted; but the vein could not be discovered, and the search for it was given up. Oxyd of tin was found in the same stream. The county of Wicklow has no large town, and has only the two members for the county to represent it in parliament. —Frazer’s Survey, Beaumont’s Memoir. Radcliffe’s Report. Griffith’s Report, &c.

WICKLOW, the affize-town of the preceding county, which is also a port-town. It is pleasantly situated on a small harbour, and near a beautiful strand abounding in fine pebbles, which is called the Murrough. The ale of Wicklow has been long celebrated in Dublin. It is 24 miles S.S.E. from Dublin.

WICKWA, a small lake of Canada, at the eastern extremity of Lake St. John.

WICKWAR, anciently WICKEN, a market-town in the hundred of Grombald’s Ash, in the county of Gloucester, England, is situated 19 miles S.W. from Gloucester, and 108 miles W. from London, and confines of one long street. The town is incorporated and governed by a mayor and twelve aldermen. It has a weekly market on Monday, and two yearly fairs. In it two courts are held; one for the borough, and another for the tything, or foreign, which have separate confitables. The clothing manufacture, which once flourished here, has long been on the decline; but the lower claffes are still employed in spinning for the clothes of other places. Wickwar contains a well-endowed free grammar-school, which was founded in 1684. The church, a handsome building on an eminence, consists of a nave and north aisle. The rector is valued in the king’s books at 18l. The resident population in 1801 was 764; in 1811 it had increased to 805. —Hilt. of the County of Gloucester, by the Rev. Thomas Rudge, B.D. Gloucester, 1823, 2 vols. 8vo.

WICLLIFF, DE WYCLIFF, WICLEF, or WICKLEFE, JOHN, in Biography, the earliest reformer of religion from Popery, was born about the year 1324 in Yorkshire, near the river Tees, in a parish whence he takes his name. He was educated at Oxford, first as a commorner of Queen’s college, and then at Merton college, peculiarly celebrated at that period for its learned members. His industry and talents soon raised him to distinction; and he is said to have committed to memory the most abstruse parts of Aristotle, and to have excelled in his acquaintance with the subtleties of the school divinity. He was also eminently skilled in civil and canon law, and in the law of the land. But the study which led to his future fame was that of the Scriptures; to which he added a diligent perusal of the Latin fathers, and of the writings of the English divines, Robert Groshead and Richard Fitz-Ralph. In his treatise “Of the Last Age of the Church,” at the early period of the year 1357, he remonstrated against some Papal corruptions; and in 1360 he was active in opposing the encroachments of the Mendicant Friars, who interfered with the jurisdiction and statutes of the university, and took all opportunities of enticing the students from the colleges into their convents. In the following year, such was the credit he had acquired by his conduct and writings, he was appointed master of Balliol college, and was preferred to a living in Lincolnshire. At this time he was held in such esteem by archbishop Simon Fitzlip, that in 1365 he constituted him warden of Canterbury college, which he had just founded; but on occasion of a dispute between the regular and secular priests, Wickliffe and the three secular fellows were rejected; and on an appeal to Rome, the sentence against Wickliffe was confirmed in 1370. His reputation in the university was not at all diminished by his exclusion. In 1372 he took the degree of D. D., and read lectures, which gained him such applause, that whatever he said was regarded as an oracle. The impurities of the monks were the objects to which his first attacks were particularly directed; and the circumstances of the times favoured his design. The court of Rome was now enforcing by menace its demands on king Edward III. of the homage and tribute to the see of Rome, which had been ingloriously stipulated by king John; and the parliament had determined to support the king in his refusal. A monk appeared as an advocate on behalf of the claims of Rome; and Wickliffe’s reply caused him to be favourably regarded at court, and procured for him the patronage of the king’s son, John of Gaunt, duke of Lancaster. In 1374 Wickliffe was joined in an embassy to Bruges, the object of which was to confer with the papal nuncios concerning the liberties of the English church, on which the usurpations of Rome had made unwarrantable encroachments. In the same year the king presented him to the valuable rectory of Lutterworth, in Leicestershire; and in the following year he was instilled in a prebend of the collegiate church of Welbuly, in Leicestershire. Wickliffe, by his foreign mission, had an opportunity of acquainting himself with the corruption and tyranny of the court of Rome; and both his lectures and conversations were amplified with invective against the pope. Whilst he defended the authority of the crown and the privileges of the nobles against all ecclesiastical encroachments, he censured vice and corruption in all ranks of society. This conduct, though it raised his reputation among the people, excited a host of enemies, who selected from his writings nineteen articles, which they deemed heretical, and which,
as such, they transmitted to Gregory XI. In 1377 this pontiff returned three bulls addressed to the archbishop of Canterbury and the bishop of London, ordering the seizure and imprisonment of Wickliffe; or, if this measure failed, his citation to the court of Rome; and also a requisition to the king and government to affill in extinguishing the errors which he had propagated. Edward died before the bulls arrived; and the duke of Lancaster, uncle to the young king, had great influence in the administration. When Wickliffe, therefore, was cited to appear at St. Paul's church before the two prelates, possessing plenitude of power, he thought it necessary to secure himself by the protection of that powerful patron. On the appointed day he appeared at St. Paul's, in the midst of a vast concourse of people, and accompanied by the duke of Lancaster, and lord Henry Percy, earl-marshall. The bishop of London was very impatient, and angry words passed between him and the two lords; so that the whole assembly was tumultuous, and nothing was done. Wickliffe afterwards appeared before the two prelates in Lambeth palace, and delivered an explanation of the articles objected against him. The Londoners, who were apprehensive that he might be severely treated, flocked in crowds to the palace; and a messenger from the queen forbade the delegates to proceed to a definitive sentence. Gregory soon after died, and his commissary expiring with him, Wickliffe escaped, but not without a severe ill-nature, which was the consequence of his anxiety and fatigue. His spirits, however, were unbroken, and he was firm in maintaining opinions which the friars, by all the efforts of intimidation, urged him to renounce.

Upon his recovery, he presented to the parliament, in 1379, a paper against the tyranny and usurpations of Rome; and he also drew up some free remarks on the papal supremacy and infallibility. But his most effectual attack on the corruption of religion was his translation of the Bible into English. This occupied many of the last years of his life, and remains a valuable relique of the age in which it was performed, and a permanent memorial of the talents and industry of the perfon by whom it was accomplished. (See English Bibles.) By way of preparation for his Bible, he published a treatise "Of the Truth of the Scripture," in which, as well as in a prologue or preface to his translation, he held, long before any of our other reformers or advocates for the sufficiency of Scripture, that this is the law of Christ, and the faith of the church; that all truth is contained in it; and that every disputation which has not its origin thence is profane. "The truth of the faith," says he, "shines the more by how much the more it is known—nor are those heretics to be heard who fancy that seculars ought not to know the law of God, but that it is sufficient for them to know what prelates and prelates tell them by word of mouth; for the Scripture is the faith of the church, and the more it is known in an orthodox sense the better; therefore, as seculars ought to know the faith, so it is to be taught men in whatsoever language is best known to them.

D-fides, since the truth of the faith is clearer and more exact in the Scripture than the prelates know how to express it—it seems useful that the faithful should themselves search out and discover the sense of the faith, by having the Scriptures in a language which they understand. The heads which the prelates make are not to be received as matters of faith; nor are we to believe their words or disburse any farther unless they are founded on the Scriptures. Furthermore, with much more to the same purpose, and in the same admirable strain. In this preface, and several other publications and treatises still in manuscript, he reflected severely on the corruptions of the clergy, condemned the worship of saints and images, the doctrine of indulgences, pilgrimages to particular shrines, and confession; and also denied the corporal presence of Christ in the sacrament, inveighed against the wanton exercise of the papal power, and opposed the making of the belief of the pope's being head of the church an article of faith and salvation, censured the celibacy of the clergy, forced vows of chastity, exposed various errors and irregularities in the hierarchy and discipline of the church, and earnestly exhorted all people to the study of the Scriptures.

In his lectures of 1381, he attacked the Popish doctrine of transubstantiation, concerning which he laid down this fundamental proposition; viz. that the substance of bread and wine still remained in the sacramental elements after their consecration, and that the host is only typically to be regarded as the body of Christ; and he deduced from it sixteen conclusions. This attack alarmed the church, which regarded transubstantiation as the most sacred tenet of the Romish religion, and the chancellor of Oxford pronounced a condemnation of these conclusions. Wickliffe appealed from this sentence to the king; but he found himself defrayed by his protector, the duke of Lancaster, who had no further occasion for his services, or who could not avail himself for any political purpose of his theological discussions. This circumstance, he found himself in danger; his resolution failed him, and he humbled himself by making a confession at Oxford, before the archbishop and his bishops, with other clergy, who had already condemned some of his tenets as erroneous and heretical. In this confession, he admitted the real presence of Christ's body in the sacrament, with some explanations and reasons which were not satisfactory to his perceptors. It has been said that he made a public recantation of the opinions with which he was charged; but of this no sufficient evidence appears. The next step in their proceedings against him was a royal letter; procured by the archbishop, addressed to the chancellor and prelates, and directing them to expel from the university and town of Oxford all who should harbour Wickliffe or his followers, or hold any communication with them. These proceedings obliged him to withdraw, and to retire to his recollection at Lutterworth, where he continued to preach reformation in religion, and finished his translation of the Scriptures. Some have said that king Richard banished him out of England; but if that were the case, it was only a temporary exile, and he returned in safety to Lutterworth. In 1383 he had a paralytic stroke, which furnished him with an apology for not appearing to a citation of pope Urban VI.; and this was succeeded by a second attack, which terminated his life on the last day of December 1384.

His remains, however, did not escape the vengeance of his enemies many years after his death; for the council of Constance in 1415, not content with condemning many propositions in his works, and declaring that he died an obstinate heretic, with impotent malignity ordered his bones to be dug up and thrown upon a dunghill. This sentence was executed in 1428, in consequence of a mandate from the pope, by Fleming, bishop of Lincoln, who caused his remains to be disinterred and burnt, and the ashes to be thrown into a brook. "Thus," says Fuller, the church historian, in a figurative strain justified by fact, "this brook hath conveyed his ashes into Avon, Avon into Severn, Severn into the narrow seas, they into the main ocean; and thus the ashes of Wickliffe are the emblem of his doctrine, which now is dispersed all the world over." His doctrine not only survived these impotent attempts to extinguish it, but was perpetuated and diffused by his followers, who were called Lollards; and "this germ of reformation," as one of his biographers
biographers says, "broke forth into complete expansion, when the feason for that great change was fully come." Of his general character, it will be sufficient to say, that he was conffedly learned for his age, and was an acute reasoner. In short, notwithstanding certain errors and imperfections, he may be regarded as a person of extraordinary merit and qualifications, who is entitled to honoured remembrance from every foe to ecclesiastical tyranny and impiety; and we may add that he advanced principles which have not yet produced their full effect.

The number of tracts he wrote and published, both in Latin and English, is very considerable. From two large volumes of his works, entitled "A Theologia, i.e. Truth," and a third under the title of "Trialogus," John Hius is said to have derived most of his doctrines. We have a full and complete "History of the Life and Sufferings, and various Writings of Wickliffe," both printed and MS., published in 1600., at London, in the year 1729, by Mr. John Lewis; who also published, in 1731, "Wickliffe's English Translation of the New Testament from the Latin Version, called the Vulgate." This translation is enriched with a learned preface by the editor, in which he enlarges upon the life, actions, and sufferings of this eminent reformer. Biog. Brit. Mofh. Eccl. Hist. Neal's Hist. of the Puritans. Gen. Biog. For an account of his differing fitting tenets, and of his followers, see Wickliffists and Lollards.

WICOMICO, in Geography, a river which rises in the state of Delaware, enters the state of Maryland, and passes into Fithing bay, on the coast side of the Cheapeap, N. lat. 38° 16'. W. long. 75° 37'.

WICOMOCO, a river of Virginia, which runs into the Cheapeap, N. lat. 37° 55'. W. long. 76° 25'.

WICQUFORT, Abraham, in Biography, was born at Amfterdam in 1508, and having left his own country for France at an early age, he was nominated resident for the elector of Brandenburg at the French court, and held the office for thirty-two years. But being suspected by cardinal Mazarin of communicating secrets to his correspondents in Holland with regard to the amours of Lewis XIV., he was ordered, in 1658, to leave the kingdom; but in the mean time he was arrested, and confined in the Baftile. At length, in 1659, he was releaved and difmissed. However, in three months the cardinal recalled him, and fetted him on a pension. On occasion of the war between France and Holland in 1672, he returned to his own country, and was protected by John de Witt, who employed him in writing a history of Holland to his own time. In 1676 he was arrested and condemned to perpetual imprisonment, under an accusation of carrying on a secret correspondence with the enemies of the state; and after having been confined for three years, he made his ecape by the contrivance of one of his daughters. He then sought refuge at the court of Zell, from which he returned to Holland in 1681, where he lived without moleftation, but without recovering the places of which he had been deprived. In the following year, 1682, he died. The work on account of which Wicqufort is best known, is entitled "L'Ambaffadeur et ses Fonctions," first printed at the Hague in 2 vols. 4to. 1681, and often reprinted. He holds in high estimation the privileges of the order to which he belonged, as we may infer from his cenure of Cromwell's spiritual act of justice in executing the brother of the Portuguese ambaffador for a murder; nevertheless he inculcates found morality with regard to the conduct of diplomatists in the countries to which they are fent. His other works are, "Memoires touchant les Ambaffadeurs et les Miftres;" one volume of his "History of the Dutch Republic," which appeared in French at the Hague in 1719, fol.; and translations into French of the accounts of different embaffies, and also of voyages and travels. More. Gen. Biog.

WIRCANGE, in Ornithology, an English name for the mattagels, or greater butcher-bird, the lanius cinereus major of authors.

WIRCANTUM, in Natural History, a name given by the people of the East Indies to certain fowl bodies, of the nature of the pyrites, of the size of peas, and formed into variously angular figures. They look black and glossy, and much of the nature of blende, or mock-lead; but when put into the fire, they shew us by their smell that they contain Sulphur. They are found in the diamond-mines.

The natives first powder them; and then mixing them with the juices of certain plants, they dry them, and then calcine them again. These proceed in least at least fifty times; but the first calcinations are made with a mixture of divers unres, as that of the horfe, the camel, the cow, and the like.

After this tedious preparation, they are given in coughe and colds, and are said to be a remedy even in consumptions.

WICZENIECZ, in Geography, a town of Poland, in Podolia; 6 miles N.W. of Kamniec.

WIDAWA, a town of the duchy of Warsaw; 22 miles S.W. of Siradra.

WIDDAN, a river of Germany, which joins the Rodau at Rotenburg, in the county of Verden.

WIDDY, in Agriculture. See WITHE.

WIDE, is used in some places to denote a small vale, and also a wide piece of water, or pond.

WIDE-ENDED, in the Mange, is applied to a horse, when the root, or lower part of his ear is placed too low, and the ear itself is too large. The French ufe the term oreillard for a fuch a horfe.

WIDE Bay, in Geography, a bay on the eait coast of New Holland, between Double Island Point and Indian Head.

WIDE Mouth Bay, a bay of England, on the N.W. coast of Cornwall. N. lat. 50° 46'. W. long. 5° 19'.

WIDEKINDI, or WIDICHINDI, JOHN, in Biography, a Swedish historian, was born in the province of Wettland, about the year 1620, and studied at Upsal, where he delivered an oration in 1654, on occasion of queen Christina's accession to the throne; and by her recommendation he was appointed historiographer of the kingdom. In 1656 he proposed printing his "History of Gustavus Adolphus," and measures were taken for this purpose; but he died at Stockholm in 1678, before the work was executed. The first part of this history was published in 1691, fol.; but as it much offended both the Danois and Russians, it was suppressed by the king's command. It is not known whether he completed the work in MS.; but the part published is written in a dull, heavy style, and it has been carelessly printed. The author, however, was a man of learning, well acquainted with history, and reckoned a good Latin poet. He polifhed an excellent library, and was much respected by King Charles Gustavus, who called him his philosopher. The most important of his works, a catalogue of which is given in "Schiller's Scotia Litterata," is the "History of the Russian War," written both in Latin and Swedish, 1672, 4to. Gen. Biog.

WIDERDRIESS, in Geography, a town of the duchy of Stirta; 2 miles S. of Windfield Gratz.
WIDJITZE, a town of Bohemia, in the circle of Czsalau; 8 miles W. of Czsalau.

WIDMINNEN, a town of Prussia; 14 miles N.W. of Lieck.

WIDOW, VIDA, a woman that has lost her husband.

Some also use the term widow, for a man who has lost his wife. Marriage with a widow is a kind of bigamy in the eye of the canon law.

The widow of a freeman of London may use her husband's trade as long as she continues a widow.

Mr. Kerseboom has given us a table, shewing how long our hundred and thirty-two widows lived, and finds, that, as a medium, each lived fourteen years. Philo. Trans. N. 468, sect. 3.

It appears, in Germany, the number of widows lying annually is four times the number of widowers; thus, in Dresden alone, the number of widows who died in four years was 584; the number of widowers 149; i.e. 4 to 1. At Wittenberg, during 11 years, 98 widowers died, and 376 widows. At Gotha, during 20 years, 210 widowers died, and 760 widows. As and widows are certainly, one with another, several years younger than widowers, it may be concluded that the number of the former in life together could not be less than five times the latter.

Thus also, in 1770, the number of widows in life, derived from the whole body of professors and ministers in Scotland, was 380; but the number of widowers among them has, one year with another, been scarcely 90; i.e. not so much as a quarter of the number of widows. Price's Observ. on Rev. Paym. eff. 4.

These facts cannot be accounted for without admitting the greater mortality of males. See Marriage, and Mortality.

There have been many schemes established for providing annuities for widows, for an account of several of which, see Price's Observ. &c. chap. ii. sect. 1, 2, 3.

Among the ancient Greeks, widows had the care of the eternal fire of Velia committed to them; which charge among the Romans could be performed by virgins only, who from their office were called vestals. See Vestal.

Widow of the King, was she, who, after her husband's death, being the king's tenant in capite, was driven to recover her dower by the writ De dote afferenda; and could not marry again without the king's consent.

Widow Benefy, in the county of Suffex, is that share which a widow is allowed of her husband's estate, beside her jointure.

Widow's Chamber, a name given in London to the apparel and furniture of the bed-chamber of the widow of a freeman, to which she is entitled.

Widow-Wall, in Botany. See Cneorum.

WIDURIS, in Natural History, the name of a ftoe found in Java, Malabar, and some other places, and described by Rumphius. Some species of this are all over of a fine white; others are of a dulky colour, with streaks of white; the filmy white ones are semi-pellucid, and look very like the white of an egg. Some also have called this baubula, or acetab vitrea pircficultulis.

WIECK. See WEEK.

WIED, in Geography, a county of Germany, situated to the north of Treves, in the year 1560, divided into two parts: the Lower County, or New Wied; New Wied; and the Upper County, or Wied Runkel. Both had seats in the college of Welfphalia counts.

WIED, New. See Neuwied.

WIE, or Old Wied, a town of Germany, in the county of New Wied; 9 miles N. of Coblenz.

WIEDENBRUCK, a town of Welfphalia, in the bishopric of Osnabruck; 32 miles S.S.E. of Osnabruck. N. lat. 51° 45'. E. long. 8° 18'.

WIEDERAU, a town of Saxony; 5 miles N. of Liebenwerda.

WIEDERSBERG, a town of Saxony, in the Vogtland; 8 miles W.S.W. of Oelsnitz.

WIEDERSPACH, a town of Germany, in the margravey of Anspach; 6 miles W. of Anspach.

WIEGANDSTHAL, or Wiegenthal, a town of Upper Lusatia; 11 miles S. of Lauban.

WIEHE, a town of Thuringia; 26 miles N.E. of Erfurt. N. lat. 51° 18'. E. long. 11° 35'.

WIELAND, Christopher Martin, in Biography, was the son of a Protestant clergyman at Biberach, in Swabia, where he was born in September 1733. Educated by his father, he began at the early age of thirteen to distinguish himself by his Latin and German poems; and he pursued his education at Magdeburg and at Erfurt. Upon his return home he became affectionately attached to Sophia de Guterman, afterwards known by her works under the name of Mad. de la Roche. In the year 1750 he studied jurisprudence at Tubingen; but his time was chiefly devoted to the writing of verses, so that in 1752 he published a didactic poem in six cantos, entitled "The Nature of Things;" "Auto-Ovid, or the Art of Love;" and "Moral Letters and Tales." He also began an epic poem, on the subject of Arminius, the first five cantos of which he sent to the famous Swiss poet Bodmer; and he was thus led to visit Switzerland, and to cultivate a friendship with this celebrated poet, and to reside for some time in his house at Zurich. In this retired and tranquil situation, he applied with great diligence to the study of the belles lettres, and acquainted himself with the principal modern languages, such as English, French, and Italian, to which he afterwards added the Spanish and Portuguese. He also read Plato with great attention, and wrote several works, among which were the "Trial of Abraham," and "Letters of the Dead." After a residence of seven or eight years in Switzerland, he quitted this country, having formed his taste on the models of Euripides, Xenophon, and Shaftsbury, whose writings he had diligently studied; and in 1758 he published his "Araepes and Panthea," a work which manifests the ascendency which judgment and moral sentiment had acquired over his imagination. Upon his return in 1760 to his native city, he was appointed a director of the chancellery, which office he held till the year 1769, referring, however, some leisure moments for the composition of his philosophical romance, entitled "Agathon," and his beautiful didactic poem "Mufarior." About this time he became intimately acquainted with count Stadion, a nobleman who lived with splendideur near Biberach, who had cultivated a taste for literature, and whopossessed an excellent library. He afterwards received from the elector of Mentz an invitation to be professor of philosophy and the belles lettres at Erfurt, and during his residence in this place he became acquainted with Anna Amelia, duches dowager of Weimar, a patroness of polite literature, and in 1772 the appointed him tutor to the two princes, Charles Augustus and his brother Constances, of whose she was guardian. In this situation he occupied himself in preparing a variety of works, both in prose and verse, which have done honour to German literature. He was at this time a live counsellor of the duke of Saxe Weimar, with a pension, and a counsellor of government to the elector of Mentz. Wieland married his favourite daughter Charlotte to a bookeller at Zurich, who was a son of the celebrated poet Solomon Gefner. In 1797 he visited
visited his children at Zurich, and retired with his family in a romantic situation on the border of the lake, where he was visited by the most eminent literati of Switzerland. Conceiving a fond attachment to a rural retreat, he held his house at Weimar, and purchased a small estate in the neighbour-

hood, where he fixed his abode. Although his fortune was small, his disposition was liberal; and he affiliated many distinguished young poets and authors for their contributions to the German Mercury, which he commenced in the year 1783. To the ex-monk Reinhold, who had escaped from Vienna, he was a generous patron, and gave him one of his daughters in marriage. This monk was afterwards professor of philosophy at Kiel. He also supported another monk, who had fled to him from a Cisterian monastery in Swabia, during his residence at Jena, where he studied philosophy. Wieland had married in 1765 a person of good family at Augsburg, of whom he expresses himself in the highest terms of respect and affection; and by whom he had thirteen children; "found," he says, "in body and mind; with their mother, they form the happiest of my life." In 1807 this venerable poet was elected a member of the floral order at Nurem-

berg; and in 1808, Buonaparte sent him the crofs of the legion of honour. After the battle of Jena, he was protected by a special order of that conqueror. He died in January 1813, in his 80th year. For the delineation of his talents and character by Kuttner and others, and an account of his works, which were very numerous, we must refer to his article in the General Biography, observing that his original works have been published in thirty-six large 4to volumes, and six supplementary volumes. Leipzic, 1794—1802.

WIELAS, in Geography, a town on the easter coast of the island of Gdino. N. lat. 1° 9'. E. long. 128° 30'.

WIELCZYNY, a town of Lithuania, in the palatinate of Novogrodjeck; 40 miles S.E. of Slomnitz.

WIELDEMANN. See Wilde-man.

WIELSEN, a town of the Duchy of Warsaw; 46 miles N.W. of Posen.

WIELICHOW, a town of the Duchy of Warsaw; 25 miles S.S.W. of Posen.

WIELICZKA, a town of Austrian Poland, celebrated for its salt-mines, which produce a great revenue to the em-

peror, to whose lot it fell in the year 1773. The inhabitants reside chiefly in the mines, and the church is under-

ground; 8 miles S. of Cracow. These salt-mines, with the territory belonging to them, were assigned to the em-

peror of Austria by the treaty at Vienna in 1815.

WIELON, a town of Samogitia; 20 miles S. of Roifenne.

WIELUN, a town of Poland, in the palatinate of Siradja; 16 miles S. of Siradja.

WIEN, a river of Austria, which runs into the Danube at Vienna.

WIENNERHORBEK, a town of Austria; 12 miles W. of Brug.

WIENNERWALD, or The Forest of Vienna, the south part of the arch-duchy of Austria, bordering on Hungary.

WIEPERZ, or WIPZ, a river of Poland, which runs into the Viftula, near Stericza, in the palatinate of San-
domirz.

WIER, John, in Biography, a physician, was born in 1515, at Grave on the Meuse; and being domiciliated with the famous Cornelius Agrippa, adopted his opinions with regard to the occult sciences. After having studied at Paris and Orleans, he took the degree of M.D. about the year 1534.

In the course of his travels, he visited the court of the duke of Cleves, and was appointed his physician. He died at Tecklenburg, in Westphalia, in 1586. He was a man of considerable learning; and though participating in a great degree the credulity of the age, he incurred the en-

mity of the monks by ascribing to deception and imposture the forcery, witchcraft, and magical practices, which they supported, to the operation of natural caules. The turn of his mind is discernible in his book "De Daemonum Pref-
tigatis et Incantationibus." In his treatise of medical ob-

servations he has given an account of the putrid fore throat, under the name of "Angina pestilentialis." Among his other writings are enumerated "De Iter Morbo, et ejus Curatione Philosophica, Medica, et Philosophica; "Trac-

tatus de Commentitiis Jejuiniis; "De Tulli Epidemica, Anno 1580; "De Varenis, Morbo endemio Westphal-

in which case, they are absolutely and entirely his own: and shall go to his executors or administrators, or as he shall bequeath them by will, and shall not revest in the wife. But if he dies before he has reduced them into possession, so that at his death they still continue chesf in action, they shall survive to the wife.

Thus in both the species of property the law is the same, in case the wife survives the husband; but, in case the husband survives the wife, the law is very different with respect to chattels real and choses in action; for he shall have the chattel real by survivorship, but not the choses in action; except in the case of arrears of rent, due to the wife before her coverture, which in case of her death are given to the husband by the statute 32 Hen. VIII. cap. 37:

As to chattels personal (or choses in possession), which the wife hath in her own right, as ready money, jewels, household goods, and the like, the husband hath therein an immediate and absolute property, devoted to him by the marriage, which can never again revest in the wife or her representatives.

The wife also, by marriage, acquires a property in some of her husband's goods, called her parenomata, which shall remain to her after his death, and shall not go to his executors. These, signifying the apparel and ornaments of the wife, suitable to her rank and degree, the husband cannot devise by his will; though during his life perhaps he hath the power (if unkindly inclined to exert it) to sell them or give them away. But if she continues in the use of them till his death, she shall afterwards retain them against his executors and administrators, and all other persons, except creditors where there is a deficiency of affects. And her necessary apparel is protected even against the claim of creditors.

The wife can make no contract without her husband's consent; and, in all law-matters, sue vro respondere non potest.

The husband is bound to provide his wife with necessaries by law, as much as himself; and if the contracts debts for them, he is obliged to pay them; but for anything besides necessities, he is not chargeable. Also if a wife elopes, and lives with another man, the husband is not chargeable even for necessities, at least if the person who furnishes them is sufficiently apprized of her elopement.

If the wife be indebted before marriage, the husband is bound afterwards to pay the debt. If the wife be injured in her peron or property, she can bring no action for redress without her husband's concurrence, and in his name as well as her own; neither can she be sued, without making the husband a defendant. There is indeed one case where the wife shall sue and be sued as a semp sola, viz. where the husband has abjured the realm, or is banished; for he is then dead in law. See Custom of London.

In criminal prosecutions, the wife may be indicted and punished separately; for the union is only a civil union. But in trials of any sort, they are not allowed to be evidence for or against each other. However, where the offence is directly against the person of the wife, the rule has been usually dispensed with; and, therefore, by Stat. 3 Hen. VII. cap. 2. in case a woman be forcibly taken away and married, she may be witnesses against such her husband, in order to convict him of felony. See FORCIBLE ABDUCTION.

In the civil law, the husband and wife are considered as two distinct persons, and may have separate estates, contracts, debts, and injuries; and, therefore, in our ecclesiastical courts, a woman may sue and be sued without her husband.

But, though our law in general considers man and wife
WIG

as one person, yet there are some instances in which she is
separately considered; as inferior to him, and acting by his
compulsion. And, therefore, all deeds executed, and acts
done by her during her coverture, are void; except it be a
fine or the like matter of record, in which case she must be
solely and secretly examined, to learn if her acts be voluntary.
She cannot by will devise lands to her husband, unless
under special circumstances; for at the time of making it
she is supposed to be under his coercion. And in some
d felonies, and other inferior crimes, committed by her
through consent of her husband, the law excuses her;
but this extends not to treason and murder. See FEME-
Covert.

The husband also, by the old law, might give his wife
moderate correction; but this power of correction was con-
fined within reasonable bounds, and the husband was pro-
bited from using any violence to his wife. The civil law
gave the husband the fame, or a larger authority over his
wife; allowing him, for some misdemeanours, flagellis et
futibus acriter verberare uxorem; for others, only modicum
calligationem addibere. But, with us, in the politer reign of
Charles II., the power of correction began to be doubted;
and a wife may now have security of the peace against her
husband, or, in return, a husband against his wife. The
courts of law will still permit a husband to restrain a wife of
her liberty, in case of any gross mischief. Blackf.
Com. book i. book ii.

If a wife bring forth a child during her husband’s absence,
though of many years; yet if he lived all the time inter
quater maria, within the four, he must father the child;
and the child, if first born, shall inherit. See BASTARD.

If a wife bring forth a child begot by a former husband,
or any other person, before marriage, but born after mar-
rriage with another man; this latter must own the child,
and that child shall be his heir at law.
The wife, after her husband’s death, having no jointure
settled before marriage, may challenge the third part of his
yearly rent of land, during her life; and, within the city
of London, a third part of all her husband’s moveables for
ever. See DOWER, INTESTATE, and CUSTOM OF LONDON.

The wife partakes of the honour and condition of her
husband; but none of the wife’s dignities come, by mar-
rriage, to her husband.

Yet, the husband, who marries a woman seised of lands
in fee-simple, or fee-tail, i.e. of any estate of inheritance,
and has by her issue born alive, which was capable of her
estate, shall, on the death of his wife, hold the lands for his
life, as tenant by the curtesy of England.

The English laws are generally esteemed by foreigners as
very hard, in respect to the women; and yet Chamberlayne
is of a very different opinion, asserting, that the condition
of wives in England is better than in any other country.

The dispositions to which the wife is subject are for the
most part intended for her protection and benefit. So great
a favourite (says judge Blackstone) is the female sex of the

Tertullian has two books, on the ornaments, and attire of
wives. In the second, he labours to prove that a Christian
wife cannot, in conscience, endeavour to please by her
beauty, which she knows to be naturally liable to ratie loose
defiles; and that she ought not only to avoid all affected
beauty, but even to conceal and cover her natural beauty.

WIFE, Mid. Offeries. See DELIVERY.

WIFFLISBORG, in Geography. See AVENCHES.

WIGAN, a borough and market-town in the hundred of
Welf-Derby, and county of Lancashire, England, is
feated near the rise of the river Douglas, the banks of which
are noted for a celebrated battle fought between king Arthur
and the Saxons, when the latter were defeated. In
the time of Henry VIII., Wigan is described by Leland as a
“paved town, as big as Warrington, but better built,
and inhabited by some merchants, artificers, and farmers.”
In its present state, it has a neat though irregular appear-
ance; and has been lately much improved by the opening of
two new streets, and the erection of several handsome
buildings. An extensive trade is carried on in the manufac-
ture of coarse home-made linens, checks, calicoes, fustians,
and other cotton goods. Here are also large brazes and
pewter works.

Wigan is a borough by prescription, and has had its pri-
ileges confirmed by the several charters of Henry III.,
Edward II., Edward III., Richard II., and Charles II.
Its corporate body consists of a mayor, recorder, twelve
aldermen, and two bailiffs. Two members are returned to
parliament; and the right of election is vested in the free
burgesses, in number about 200. The representation of
this borough has occasioned some very expensive contests;
and it is said to have cost George Byng, esq. 10,000l.
in his opposition to the interest of sir Fletcher Norton, and
Simon Luttrell, esq. Returns appear to early as the 23d
and 35th Edward I., after which the privilege was suffered
to be dormant for 240 years; no other return being made
till 17 Edward VI.

The parish-church is ancient, and considered to be a
handsome structure; it consists of a nave, a spacious chancel,
and two side-aisles. Among the monuments in the church
there is one to the memory of sir Roger Bradlaugh, and another
to sir William and lady Mabel Bradlaugh. The remains
of George Hole, rector of this church and bishop of
Chefter, are deposited within the communion-rails. He
died August 23, 1668. The rectorcy is one of the best en-
dowed in the kingdom, and the incumbent is always lord of
the manor. In the town is a chapel of ease, three chapels
for dissenters, and one for Roman Catholics. A town-hall
was built in 1721, at the joint expense of the earl of Barry-
more and sir Roger Bradlaugh, the then representatives of
the borough. A free-school was erected, and liberally en-
dowed, about the beginning of the last century, by volun-
tary contribution; and upwards of 30 years ago, the same
liberality established a blue-coat school for 30 boys. A
commodious workhouse has been also built at the expense of
the inhabitants of the town, where the necessitous and super-
annuated poor are comfortably accommodated; industri
in the more able are furnished with the means, and the meri-
torius are encouraged and rewarded. A dispensary has
been erected, and is supported by the benevolence of the in-
habitants of the town and its vicinity.

At the north end of the town is a monumental pillar,
erected in 1679 by Alexander Rigby, esq., then sheriff of
Lancashire, to commemorate the valour and loyalty of sir
Thomas Dyleley, who was slain on this spot in 1651, in
the action wherein the earl of Derby was defeated by colonel
Lilburne.

In a field near Scholes-bridge, contiguous to this town,
a spring was lately discovered, which has obtained the name
of Wigan Spa, or New Harrowgate, as the water resem-
bles that of Harrowgate in Yorkshire.

The population of Wigan, which has been progressively
increasing, was, in the year 1801, according to the return
to parliament, 10,989; the number of houses, 2236. In
1811, the former had increased to 14,460, and the latter
to 2686.

The parish of Wigan contains twelve townships, in three
of which, besides that in the town, are chapels of the esta-
blishment,
The first manufactories establisht here were for different kinds of coarse linens; but since the year 1783, this busi-
ness has received a confiderable check by the encouragement
given to the various branches of the cotton trade, which
flourish in great vigour. In 1790 a manufactory for print-
ing calicoes was establisht at Spittle, about a quarter of a
mile from the town, and seems likely to become an im-
portant undertaking, as the goods are in high repute, and
the situation extremely convenient for extending the works.

The present church was erected in 1758; its neatness is
eminentiy contrasted with the ancient fabric, which was a
dark gloomy structure, built, according to the Chronicon
Cumbriae, by Odoard de Logiz, to whom the barony was
given by Waldef, son of earl Gofpatrick. The materials
it was constructed with were procured from the Roman sta-
tion at Old Carlisle, as appears from the stones being marked
in a similar manner to those that may yet be obtained there.
In removing the foundations of the old tower, two Roman
episcopal inscriptions were discovered. The streets are
tolerably spacious, and many of the buildings are handsome
and modern. In the year 1723, an hospital was founded
here, under the will of the Rev. John Thomlinson, A.M.
for five indigent widows of Protestant beneficed clergymen,
episcopally ordained; and incorporated by the name of
"The Governors and Sifters of the College of Matrons,
or Hospital of Chrift in Wigton." The endowment has been
augmented by some small benefactions: the allowance to
each widow is about eight pounds annually. A free-school
was also establisht here in 1750; chiefly by the contribu-
tions of the inhabitants, aided by the benevolence of Dr.
Thomlinfon's brother. In this town, observes Mr. Gough,
was anciently an hospital or free chapel, dedicated to St.
Leonard, to which, Mr. Pegge is of opinion, belongs a seal
found in Pickering-castle, Yorkshire: it is of wood, and
has the representation of the Deity, with the crucifix, cir-
cumfcribed Sigilcom Wighton.

About one mile south from Wigton are the ruins of the
considerable Roman ftation, now called Old Carlisle, but
generally suppos'd to have been the Olancum of the Noti-
tia, where the Alae Herculae were in garrison. Vestiges
of ancient buildings are very conspicuous; the foundations
of numerous ruined edifices being scattered over many acres,
as well within the vallum as on every fide, without excepting
to the westward, where the ground descends precipitously
to the brook Wifa. The ftation itself occupied an elevated
ftice, and commanded an extensive view north and north-west.
Its form is an oblong fquare 170 paces in length and 150
broad, with obtufe angles, defended by a double ditch and
vallum, and having an entrance near the middle of each fide.
The military way, on which it flands, is very broad and
ficient, and leads immediately to Carlisle and the Wall.
Within the vallum, a well was discovered a few years ago,
about three feet in diameter, and regularly lined with ftones.
Various inscriptions, defiguring instruments, coins, altars,
small images, statues on horse-back, urns, and other veftiges
of antiquity, have been found at this ftation.

Several antiquities, discovered near this place in the
course of the laft century, have been described in different
volumes of the Gentleman's Magazine, particularly in thofe
for the years 1748, 1756, and 1757.

Clea-hall, a feat of Sir Henry Fletcher, bart., whole fa-
family obtained it by an intermarriage with the female heir of
a branch of the Muirgraves, ftands on a cultivated spot in
the midst of an elevated and dreary moor.—Beauties of Eng-
land and Wales, vol. iv. Cumberland, by J. Britton and
E.W. Brayley.
WIGTOWN, a royal borough, market-town, and the capital of the shire of the same name, Scotland, is situated on the side of a hill near the confluence of the river Bladnock, at the distance of 105 miles S.W. by S. from Edinburgh. It is of very high antiquity, and appears to have received its charter of incorporation from King Robert Bruce. The civil government is vested in a provost, two bailies, and twelve councillors. Wigtown unites with the boroughs of Whitehorn, New Galloway, and Stranraer, in sending one member to the British parliament. The church is in good repair. A well-supplied market is held weekly, and five fairs annually. Being the shire-town, the sheriffs' courts are held here. A grammar-school is established, and well conducted. The parish of Wigtown is in the form of an oblong-square, extending five miles in length and four in breadth, and comprehends about 5500 acres. The climate is cold, but remarkable for producing health and longevity. A great diversity prevails in the soil and surface; towards the south it is intersected with hills, which are almost entirely arable, with a dry, light, and fertile mould; the north-west corner is more varied and less productive; and the north-west part is principally covered with mosses, and appears to have been formerly an arm of the sea. The greater part is inclosed; and the spirit of agricultural improvement is much encouraged. Particular attention is paid to the repairs of the roads and bridges. The population of the parish, at the enumeration of the year 1811, amounted to 1711. In the western part of the parish is a large circle of stones, called "The Standing Stones of Torhouse," which is supposed to have been a temple of the Druids.—Beauties of Scotland, vol. ii. Wigtownshire. Gazetteer of Scotland, 1806. Carlile's Topographical Dictionary of Scotland, 2 vols. 4to. 1813.

Wigtown Bay, a bay of the Irish sea, on the S. coast of Scotland, at the mouth of the river Cree, between the counties of Wigtown and Kirkcudbright.

WIGHTONSHIRE, the western part of the district of Galloway, forms the south-western extremity of Scotland. It is bounded on the E. by Kirkcudbright, on the S.E. by Wigtown bay, on the S. and W. by the Irish sea, and on the N. by Ayrshire. It is of an irregular figure, of which the greatest length is about thirty miles, and the breadth nearly twelve. The superficial contents are 460 square miles, or 238,721 Scotch acres. The thre comprehends three royal boroughs, Wigtown, Stranraer, and Whitehorn; also the town of Portpatrick, and thirteen other parishes. By the population return of the year 1811, the number of houses is found to be 3402; that of the inhabitants 26,891; namely, 12,305 males, and 14,586 females. The thre sends one member to the imperial parliament, and the three boroughs unite to send another. Wigtownshire is one of the most level counties in Scotland; and the hills are in general free from projecting rocks, and very accessible to the plough. The navigation along the coast is so uninterrupted, that it may be regarded as one of the most eligible situations in the island, in point of natural advantages, for a trading district. The richest lands lie upon the coast, where the means of improvement are to be met with in the greatest abundance: the inland and more elevated parts have a considerable mixture of heath and moss, but are all in a greater or less degree susceptible of improvement. There are few mountains in Wigtownshire. The Cairnpit, near Portpatrick, is one of the most considerable: it rises 820 feet above the level of the sea. The furmint bears all the marks of having been a military station, being surrounded by three stone walls, with very ample spaces between them; and commands a prospect of Loch-ryan, and Luce bay, which by advancing inland form the peninsula, called the Rhynns of Galloway, in which Portpatrick is situated.

The rivers of this county are of no great importance. The Cree forms part of its eastern boundary. The next stream to the westward is the Bladenoich, which rises from a lake called Loch Macbeary, situated mostly between the two parishes of Kirkowen and Penningham. There are several small islands in it; upon the largest of which are the remains of a considerable building and small garden. The river Bladenoich, which has its source in this lake, runs in a south-easterly direction for about two-thirds of its length; after which it takes a more easterly course, and empties itself into the bay of Wigtown: its whole length is about twenty-four miles. Tarff is a stream which rises in the precincts of Ayrshire, and after a course of twelve miles, in a south-westerly direction, falls into the Bladenoich in the parish of Kirkowen. Luce-water is a small river, which runs into the great bay of that name. Salmon are caught in it; and it is observed that the skin of the salmon, when it first goes up the river, which is deeply tinged with mosses, is of a filthy colour, but after remaining some time, it becomes of a brownish-yellow.

Wigtownshire has several fresh-water lakes, but none of particular importance. In the parish of Sorbie is one of three miles in circumference, well floored with pike, perch, and eels. It is called Dowalton lake, because the ancient powerful chiefs, the Macdowals, had their residence near it.

In the parish of Luce are fifteen lakes, of different degrees of extent, abounding with fith of several kinds, and frequented by a variety of water-fowls. Swans emigrate from Ireland, particularly in severe winters, and continue in these lakes till spring. The thre of Wigtown is deeply penetrates by navigable bays. Wigtown bay and Luce bay advance in a direction nearly parallel far into the country towards the north. At the same time, from the northern part of the county, the long and narrow bay called Loch-ryan advances southward towards the bay of Luce, and penetrates an extensive territory, which appears to have long remained divided from the rest of Scotland. Loch-ryan is a beautiful as well as a safe and commodious bay for shipping. It is about ten miles in length from north to south; the entrance into it is near two miles broad. It is bounded on the east by the parish of Balantrae, in Ayrshire, and on the west by Millar Point, a headland in the parish of Kirkholm. About three or four miles from the mouth of the loch, on the east side, is the little village of Cairn; contiguous to which is a commodious bay with good anchoring ground, and depth of water sufficient for ships of any burthen; and all vessels entering into or coming out of the Firth of Clyde seek this bay in stormy weather. King William's fleet anchored here in their passage to Ireland. Before the Cairn bay, there are several other good anchoring bays in the loch. Luce bay, which advances from the south towards Lochryan, is far more extensive. In dark and hazy weather, vessels often mistake Luce bay for the Irish channel, and when keeping a northerly course, sometimes run on shore, before the error is discovered. The bay of Luce contains a great variety of leffer bays, some of which are capable of being converted into convenient harbours; and mariners acquainted with them find anchoring places, in which they are in safety from almost every wind. The coast around the bay of Luce is very various: in some places it consists of a fine gravel beach; at other points steep rocks project into the sea, forming a bold inaccessible shore. The most southern point of the coast, or rather of Scotland, is called the Mull of...
of Galloway: in the western side of it rises a very elevated coal; it is about the extent of a mile, and projects itself as the boundary between the Irish sea and the bay of Luce. In a high, wet, winds create a prodigious swell of the sea, rolling round the point, and is then awfully grand. Here the sea has formed caverns, which are rendered dreadful by a setting-in tide and a strong, running wind. The noise is like loud claps of thunder. Ships pass and repass this point from England, Ireland, and the west of Scotland.

Though the agriculture of this country is yet but in an inferior state, great exertions are making to bring the soil under the best management of which it is capable. Still, however, the defects of the soil, added to the imperfect state of the husbandry which has hitherto existed, greatly depress the value of the territory. The earl of Stair's estate is paid to extend to about 55,000 acres, but produces an annual rental of no more than 11,000. sterling. There are in this county great tracts of land, of that soft confidence which renders it almost inacceivable, and of no utility either for agriculture or pastoral use. Little hopes are yet entertained of the practicability of improving this fort of territory. But it is confidently asserted, that an immense field of mofs of this description below Newton Douglas might by proper management be floated into the sea, leaving some thousand acres of rich clay behind. The great trunks of trees that are found in the mofes of this county, afford full proof of its having been formerly covered with wood. The renewal of the forests, however, proves a very arduous task; and in certain exposures on the coast has repeatedly baffled the hopes of the most ingenious and attention; planters. Wood, corn, and potatoes, in this exposure, are more or less injured, according to their vicinity to the sea; whereas, when protected from it, they are found to grow with their usual vigour. Shelter, therefore, either natural or artificial, must be had on this coast before wood can be planted with any chance of success. Scottish firs, which serve to nurse up plantations in many other parts of the country, are unfortunately found to thrive worse here than any other species of wood. Under this difficulty, the earl of Galloway fortunately discovered the valuable properties of the piny West Coast, or maritime pine, which he observed to grow with a degree of luxuriance superior to any other in his plantations. He has since increased the propagation of that tree, and now finds that under its protection, almost any other wood may be planted with success. Attempts are making to introduce dairy-farms into this country, for the purpose of supplanting the universal practice of breeding cattle. One farmer, upon this plan, has no less than eighty milking cows: he uses his whole milk in the manufacture of cheese, which he exports to the Clyde. A remarkable breed of small white-faced sheep, peculiar to the coast of this county, deserves notice. It is called the Mochrum breed. These are said to be of Spanish extraction, an idea the more readily adopted, from the quality of their wool, which is of the fine English sort, of a texture superior to wool in Scotland, and but little inferior to real Spanish. This breed, which is at present of an under size, is well-shaped, hardy, and found by proper attention to improve much, both in weight of carcass and wool.

The mineral productions of the country are but few: the parish of Kirkmaiden, which forms the southern part of the peninsula that bounds the bay of Luce on the west, contains valuable quarries of slate, of which considerable quantities are wrought and sent to market. Here are several natural caverns, in one of which is a petrifying water, dropping from the roof. In the parish of Inch, situated upon Loch-ryan, are several mineral springs: one, with a fulphurous impregnation, has been found useful in stomatie and scurvy complaints. There is also a chalybeate spring. Some appearances of coal have been thought to exist here; but that valuable mineral has hitherto been sought in vain. In this quarter, towards Ayrshire, is a bold rocky shore, containing several natural excavations or caverns, extending eighty or an hundred yards under ground. The parish of Whitehorn, in the south-eastern part of the county, produces very fine variegated marble, and also slate of a strong quality. The chief natural defect incidental to this county is the want of coal, a defect common to it with almost the whole of the southern border of Scotland. Was it not for this check to the establishment of manufactures, it might be likely to assume some share of commercial importance. Though of small extent, it has an ample coal-foothold, which affords great facility for exporting the produce of its agriculture and dairies. This facility is so great, that the inhabitants of Wig-townshire are sometimes in dread of scarcity, in consequence of the greater part of their produce being carried to Glasgow, Paisley, or Liverpool, where a market is always to be obtained.—Beauties of Scotland, vol. ii. Wigtownshire, 1805. Gazetteer of Scotland, 1806.

WOOLWORM Point, a cape on the coast of Patagonia, in the thirty-sixth parallel of Magellan; 3 miles W. E. of Cape Providence.

WHACIS, or WHATS. See BHAIS.

WHENALS, a town in Sweden, in the province of Savolax; 40 miles N. of Childa.

WIHI, or WYER, a town of France, in the department of the Upper Rhine; 6 miles W. of Colmar.

WHIRBACH, a river of France, which runs into the Rhine, 7 miles above Germersheim.

WIKES, in Agriculture, a term used to signify temporary boundaries or marks, set up in order to divide the fields to be mown; such as the bounds of trees, in the common fields and meadows in different districts; as well as such bounds which set upon hay-cocks and flouks of corn for the taking of tithe, and other such purposes.

WIKINISH CREEK, in Geography, a river of Pennsylvania, which runs into the Susquehanna, N. lat. 40° 32'. W. long. 77° 1'.

WILAF, a river of Wurtemberg, which runs into the Rems, near Schorndorf.

WILBESSEN, or WILDADESSEN, a town of Westphalia, in the bishopric of Paderborn; 8 miles S.E. of Dringenberg.

WILBRHAM, a township of Massachusetts, in the county of Hampshire, with 1776 inhabitants; 10 miles N. of Springfield.

WILBURG, a citadel of Austria; 8 miles E.S. of Ips.

WILBY, JOHN, in Biography, one of our best madrigalists of Queen Elizabeth's reign. In his first set, the following are well-known: "Lady, when I behold the roses sprouting;" and "Flora gave me fairest flowers." But, "Hard by a crystal fountain," which, according to Hearne, (Lib. Neg. Scacc.) used annually to be sung by the fellows of New college, Oxon, we are unable to find. Those words are adjusted to the music of Giov. Croce, in the second book of Musica Transalpina, and are set by Morley in the Triumphs of Oriana; but appear not either in the first or second set of Madrigals published by Wilbye, and we know of no other.

WILD ALBEH, in Geography, a mountain of the duchy of Sturia; 7 miles N. N. W. of Muertzenfchlag.
Wild Angelica, Basil, Briar, Campion, Carline Thistle, Carrot, Cherries, Cistus, Climber, Lettuce, Liquorice, Marjoram, Mela, Mint, Mulberry, Oak, Radish, Rape, Rocket, Tare, Thyme, and Vine, in Agriculture. See Weed.

Wild-Fire, or Erysipelas, a disease in sheep, which affects the skin, and which, if not well attended to, is liable to spread very quickly among the flock. It is attended with considerable inflammation in many cases, though but seldom with blisters over the body. It commonly takes place towards the latter end of summer, and does not continue more than eight days at a time, although such sheep as are once affected with it are very liable to have it again. It was formerly a practice with shepherds to bury the sheep that were affected with this disease in the ground at the door of the fold, with their feet upwards, which, they believed, acted as a charm to drive it from the flock. But this folly is now done away with.

In the cure of this affection of the skin, recourse may be had to evacuations from the bowels by the use of calomel, or purging-farts, dissolved in warm water, for three or four days; then sulphur with nitre may be given in pretty full doses, cooling washes being used at the same time. Strengthening remedies should afterwards be employed, such as oak, or other barks of the same nature.

During the cure, the sheep should be kept from being too much exposed to cold, and in a dry found pasture, being well fed when necessary.

Wild-Fire, Ignis Gregalis, or Græca. See Wild-Fire.

Wild-Fire Arrows, such as were trimmed with wild-fire, and shot burning, to drive the flocks or rigging of ships in a fight. See Fire-Arrow.

Wild-Fowl. See Water-Fowl, and Decoy.

Wild-Goof. Anas Anser. See Duck.

Wild-Goose Chase. See Chace.

Wild-Honey. See Honey.

Wild-Land, Reclaiming of, in Agriculture. See Reclaiming Lands.

Wild-Olive. See Eleagnus.

Wild Service-Tree, in Agriculture and Gardening, a deciduous tree of considerable growth, which is much cultivated in the field and pleasure-ground. It has been observed, that this tree is sometimes planted in orchard-grounds among fruit-trees, but that it should be put in pleasure-grounds, plantations, or on lawns, for its ornamental effect in the autumnal season.

If trained up with straight clean stems, service-trees will grow to the height of thirty or forty feet; in that case, they should be planted among forest-trees, or in the back parts of large shrubberies. But those who wish to plant them as flowering shrubs must head them down when young, to make them throw out horizontal shoots; they may then be planted among the middling-sized shrubs, which will make a beautiful variety, both when in flower, and when bearing fruit. These trees grow to a considerable size when properly managed, and are very much used by wheelers and others, on account of the wood being all, what they call, heart-wood.

The fruit has been found excellent for feeding game, and other sorts of birds and fowls.

Wildau, in Geography, a town of the duchy of Slesia, on the west side of the Muchr; 12 miles S. of Gratz.

Wildbad, a town of Wurttemberg, celebrated for its warm-baths; 30 miles N.E. of Strafsburg. N. lat. 48° 40'. E. long. 8° 26'.

Wildberg, a town of Wurttemberg, on the Nagold; 3 miles N. of Nagold. N. lat. 48° 33'. E. long. 8° 48'.—Also, a town of Prussia, in the province of Oberland; 12 miles S. of Ortelburg.

Wildberg, or Wylbergen, a town of the Middle Mark of Brandenburg; 20 miles N. of Brandenburg. N. lat. 52° 55'. E. long. 12° 38'.

Wilde, James, in Biography, a Swedish historian, was born in Courland in 1097, and educated at Riga; and having quitted that city in 1095, he fought farther improvement in several German academies, graduating M.A. at Grieswald. At the age of 21, such was his proficiency in various branches of literature, he was appointed co-rector of the cathedral school at Riga, and soon after teacher of politics, history, and eloquence, in the royal gymnasium of that place. Qualified by his talents and acquirements for a higher rank in the department of instruction, he was invited, in 1703, to be professor of history in the academy of Pernau; but declining this office, he was, in the following year, nominated by Charles XII. to fill the chair of Latin eloquence and poetry, which he occupied for five years. During his stay at Aix-la-Chapelle, which he visited in 1709 for the recovery of his health, the Russians made an irruption into Livonia, and he lost his library, with all his documents and papers. From hence, instead of returning to his native country, he proceeded to Stockholm, and offered his services to the senate. Such were the exciting troubles at that time, that it was not till the year 1713 that government appointed him to be professor of eloquence and poetry at Grieswald. But he preferred a humble and more private situation as tutor to the two sons of count Cronhelm, with whom he made a tour to England, Holland, France, and Germany. Pursuing a similar tour with a young Holstein count, and becoming acquainted with the duke of Holstein, he was appointed his cabinet-secretary, in connection with the professorship of the law of nature and nations at Kiel. And in the same year his friend Frederick made him historiographer to the kingdom; on which office he entered at Stockholm in November 1719. His works were numerous and learned; but his constitution was feeble, so that he sank under his labours, and died in 1755. Although he was more than thirty years old when he went to Sweden, he obtained a thorough acquaintance with the Swedish history; he was also well acquainted with the public law of Germany; and in his earlier years he had raised himself by writing Latin poetry. He was also a good philosopher, and a theologian, and often preached. His memory was singularly retentive; and this served him in various works which he composed after having lost his sight in 1741. Many of his works were lost at the capture of Pernau. During his tour with the sons of count Cronhelm, he published at Frankfort, in 1717, "Diatriba de Jure et Judice Legatorum à Stephano Callio;" "Suecic História Pragmatica, qua vulgo jus publicum dicitur, &c." Holm. 1731, 40.; "The Foundation, Nature, Origin, and Antiquity of the Swedish Laws," with an Account of the Changes and Alterations which have been made in them," ibid. 1736, 40.; "Puffendorf's Introduction to the History of Sweden, with Additions, Proofs, and Notes," by J. Wilde; "I. Part," ibid. 1738, 40.; "II. Part," ibid. 1743, 40.; "Preparatio hodegetica ad Introdutcionem Puffendorfii in Sveclici ratus Historiam, &c.," ibid. 1743, 40. Gen. Biog.

Wilde, in Geography, a river of Prussian Lithuania, which runs into the Russe.
WILDEBERG, a town of Pomerelia; 2 miles S. of Marienburg.

WILDEMAN, a town of Welthphalia, in the principality of Grubenlagen, near which are some mines of silver and lead; 6 miles S.W. of Goslarn.

WILDENBERG, or WILDENBERG, a town of the duchy of Berg; 10 miles E. of Homberg. WILDENBERG, a town and castle of France, in the department of the Rhine and Moselle; 10 miles W. of Kirn.

WILDENBRUCH, a town of Hinder Pomerania; 5 miles S. of Bünau.

WILDENFELD, a town of Saxony, in the circle of Erzgebirg; 5 miles S.E. of Zwicau.—Also, a citadel in the territory of Nuremberg; 3 miles W.S.W. of Bezenstein.

WILDENBURG, or WILDENBURG, a town of the circle of Neufristadt; 2 miles N.N.E. of Weyda.

WILDENHOF, a town of Prußen, in Natangen; 23 miles S. of Brandenburg.

WILDENS, John, in Biography, was born at Antwerp in 1584. He became an admired painter of landscapes, but under whom he acquired the art is unknown. He appears to have been a diligent observer of nature, and to have indulged much in the open air; as his studies of forests, fields, &c. are numerous. When he had obtained considerable reputation, his talents introduced him to the notice of Rubens, who employed him to assist in executing the landscape parts of back-ground, which he did with so great felicity, that there appears no diffimilarity in artists in the pictures on which they both took their respective parts. Two of his best pictures are in the chapel of St. Joseph at Antwerp, embellished with figures by Lang Jan; the subject of one is the Flight into Egypt, and of the other a repose. He died in 1644, aged 60.

WILDENSCHWERT, in Geography, a town of Bohemia, in the circle of Chrudim; 9 miles E. of Hohenhain.

WILDENSCHWERT, in Geography, a town of Germany, in the margraviate of Anspach; 7 miles S.E. of Creilheim.

WILDENTHAL, a town of Saxony, in the circle of Erzgebirg; 7 miles S.S.W. of Schwartenberg.

WILDENSCHWERT, in Geography, a town of Bohemia, in the circle of Chrudim; 9 miles E. of Hohenhain.

WILDENSCHWERT, in Geography, a town of Germany, in the margraviate of Anspach; 7 miles S.E. of Creilheim.

WILDENTHAL, a town of Saxony, in the circle of Erzgebirg; 7 miles S.S.W. of Schwartenberg.

WILDERNESS, in Gardening. There is nothing so great an ornament to a large garden as a wilderness, when properly contrived, and judiciously planted. The wilderness should always be proportioned to the size of the garden, and should never be situated too near the house; because the trees perish for a large quantity of watery vapours, as makes the air very unhealthy; though vegetables serve, as modern experiments have sufficiently ascertained, to purify and temper the air. See AIR.

The wilderness should never be placed as to block up a good prospect; but where the view naturally ends with the verge of the garden, or little more, nothing terminates it so well as a fine plantation of trees. The size of the trees should be considered, and tall growing ones should be planted in larger places; smaller, in less extensive; evergreens also should be kept by themselves, and placed most in fight, not mingled confusedly among the trees which call their leaves. The walks should be large and not numerous; the large walk is best made perpendicularly, and this should not be entered upon in the grand walks of the garden, but by some private walk.

It is too common a method to dispose the trees in wilder-nes, in form of regular squares, triangles, &c. but this is faulty; for as nature should be studied in these works of fancy, the most irregular is the most pleasing plantation. The walks for the same reason are much more pleasing when they run in wild meanderer, than when they intersect one another in studied and regular angles. The winding walks should be made to lead to an open circular piece of grass, with a statue, an obelisk, or a fountain: or, if an opening large enough for a banqueting-houfe be contrived in the middle, it will afford a very pleasing scene. The trees should gradually rise from the sides of the walks and openings, one above another, to the middle of the quarters, where the larger trees should stand, by which means the heads of all the trees will appear in view, but their items will not appear in fight.

Not only the growth of trees is to be considered in the planting of a wilderness, but their nakedness are to be considered and hid. The larger growing trees are allowed a proportionable distance, and their items hid by honey-fuckles, roses, spiræas, and other low-flowing shrubs. These may also be planted next all the walks and openings; and at the foot of these, near the walks, may be set rows of primroses, violets, and daffodils, with other the like flowers; behind the first rank of lower flowing shrubs should be planted those of a somewhat higher stature, as the althaea-frutices, the cytisides and guelder-roses; and behind these may be rows of the taller flowering shrubs, as the lilacs, laburnums, and the like; and behind these, the heads only of the lower growing trees will appear, which should be backed gradually with those of higher growth to the centre of the quarter; from whence the heads of the trees should descend every way to the walks, or openings. The grand walks and openings should always be laid with turf, and kept well mowed; but, before these, there ought to be smaller serpentine walks through the feveral quarters, where persons may retire for privacy; these should be left with the bare earth, only kept clear of weeds, and laid smooth.

These walks should be made as winding as possible, and a few wood-flowers planted along their sides will have a very good effect. The ever-greens should be allotted a peculiar part of the wilderness, and such as fronts the house; and in the planting of these, the fame regard is to be had to their growth, that the taller trees be planted hindmost, and their items hid by shorter ones, and so on, down to the verge; as in the first row may be planted laurusines, boxes, spurge, laurels, junipers, and fias; behind these, laurels, hollies, and arbutus; next behind these, yews, alaternus, phileraya, cypress, and Virginian cedars; behind these, Norway and silver firs, and the true pine; and finally, behind these, the Scotch pine and pinaster. These will have a very beautiful appearance, as their tops will only be seen, and make a sheet of green, which may also be very beautifully varied, from the artful admixtures of the several shades of green which the various plants have. In all these plantations, the trees, however, should not be set in formal lines, but in a loose variety, proportioned to their manner of growth. Miller.

WILDERSDORF, in Geography, a town of Austria; on the Zeya; 8 miles W.S.W. of Zitterdorf.

WILDESCHAUSEN, a town of Welthphalia, with a district formerly belonging to the archbishopric and duchy of Bremen, and afterwards to the duchy of Brunswick, in which it is intufated. It is situated on the Hante, and contains about 312 house. The inhabitants are partly Roman Catholics; in the bailiwick are 50 villages; 20 miles S.S.W. of Bremen. N. lat. 52° 52'. E. long. 8° 27'.
WILDING, in *Rural Economy*, a four autiere fort of apple, often used with others that correct these qualities, for making home cyder. See Cyder.

WILDING, *Royal*, an excellent cyder-apple. It is said, in the Gloucester Report on Agriculture, to be a native of Dimock; that it is a fine, clean, and handsome grower; makes excellent cyder, is a great favourite among the planters in the upper part of the forest-distri t of that county, and is much introduced in the vale, on the east side of the Severn. See Cyder.

WILDS, a term used by our farmers to express that part of a plough by which the whole is drawn forwards. The wilds are of iron, and are of the form of a gallows, whence they are by some called the gallows of the plough, but improperly; the gallows of the plough being properly that part formed by the crown-plies, and the transverse piece into which they are mortised at the top. The wilds consist of two legs, and a transverse top-piece: one of the legs, and the top-piece, are all of one piece of iron; and the other leg, which is loose, has a hole in the top, into which the end of the transverse piece is received: both these legs pass through the box of the plough, which is that transverse timber through which the pinples of the wheels run. These legs are pinned behind the box with iron pins: the holes through the box at which these legs pases, are not made at right angles, but flanting upwards, so that the part of the wilds is higher than the hinder part; were it not for this, the upper part of the crown-plies would lean quite back when the plough is drawn.

The use of the notches in the wilds is to give the plough a broader or narrower furrow; if the legs are moved to the notches on the right-hand, it brings the wheels toward the left, which gives the greater furrow; and, on the contrary, a smaller furrow is made when the legs are moved to the notches on the left. The legs of the wilds should be nineteen inches, and their distance eight inches and a half; they must be made strong, and the legs must be placed in different notches, that the front of the plough may be kept steady, and the wheels not be drawn one before the other. These legs are of iron also, and are each six inches and a half long, and to these are fastened the chains of the harness, by which the whole plough is drawn along.

WILDAUBACH, in Geography, a river of Germany, which runs into the Elbe, 6 miles below Dresden.

WILDEE, a lake of the duchy of Sturia; 8 miles E. of Neumark.

WILDSHUT, a town and castle of Bavaria; 5 miles N.N.W. of Lauffen.

WILDSTADT. See WILSTADT.

WILDUNGEN, a town of Germany, in the county of Waldeck; 7 miles S.S.E. of Waldeck. N. lat. 51° 7'. E. long. 6° 8'.

WILEHENGEN, a town of Switzerland; 9 miles W. of Schaffhausen.

WILEIA, a town of Samogitia, on the Niemen; 25 miles S.S.E. of Rofienne.

WILF, in Agriculture, a term used provincially to signify the white willow. See Willow.

WILFERSDORF, in Geography, a town of Austria; 4 miles W. of Brugg.

WILHELMSDORF, a town of Prussia, in Oberland; 13 miles S. of Holland.

WILHELMSHAOF, a town of Germany, in the duchy of Anhalt Bernburg, near Hartzgerode.

WILHELMSPURG, a town of Austria; 8 miles S. of St. Polten.

WILHELMSTEIN, a town of France, in the department of the Roer; 7 miles S.W. of Juliers.

WILHELMSTHAL, or Neustadtel, a mine-town of Silicia, in the principality of Glatz; 15 miles S.E. of Glatz. N. lat. 50° 3'. E. long. 16° 42'.

WILLA, a river of Lithuania, which runs into the Niemen, near Kowno, in the palatinate of Troki.

WILINGO, a town of Sweden, in the province of Schonen; 7 miles N. of Helsingborg.

WILITZ, a town of Bohemia, in the circle of Kauzim; 5 miles N.N.W. of Kauzim.

WILKES, JOHN, in *Biography*, was born in London in 1727, and finished his studies at the university of Leyden. Soon after his return to England, he married a Miss Mead, who was a lady of large fortune, and settled at Aylesbury. This lady, though highly respectable both in her character and connections, and belonging to a diffenting family as well as himself, was older than he, and in other respects an unattractive wife, so that the attachment was originally formed, on his part, from lucrative motives: one daughter was the fruit of this connection. Mr. Wilkes, thus furnished with the means of profusion, lived in an expensive style, and being little anxious about domestic happiness, associated with the gay and licentious, to whose habits and manners his principles and character were sacrificed. Urged by his partial friends who thought him qualified for public life, he offered himself, in 1754, as a candidate for the town of Berwick, but his views were disappointed. In this and in several other instances, he counteracted the inclinations and wishes of his wife, so that their continued connection was a source of disquietude, and they determined to separate. In 1757 he was returned as a member for the borough of Aylesbury, the consequence of which was an increase of expenditure, that involved him in pecuniary embarrassments, and led him to dishonourable practices, and particularly to an attempt of freeing himself from the obligation of paying his wife’s annuity, in which he failed of success. His parliamentary patron was earl Temple, by whose influence he was chosen representative for Aylesbury; and from whose interest he expected to obtain some place under government, which the perplexity of his circumstances rendered particularly desirable. But he was once and again disappointed; and he ascribed his failure to the interference of lord Bute. In 1762 he brought himself, as a political writer, with lord Temple and Mr. Pitt, and defended them, whilst he exposed the ministry, on occasion of the rupture with Spain, in a pamphlet entitled “Observations on the Papers relative to the Rupture with Spain.” This publication was followed in 1763 by an ironical dedication to lord Bute, of Ben Jonson’s “Fall of Mortimer,” in which he indulged unrestrained levity against the “favourite,” as he was called, and his antipathy to the Scottish nation; which was further manifested in a periodical paper called “the North Briton,” commenced in 1762, and intended to counteract “the Briton,” which Smollet conducted in defence of lord Bute’s administration. The North Briton, however, was written with a spirit so contemptuous to the sentiments of the public at that period, that it probably contributed to the re-election of that nobleman in April 1763. The 45th number of this periodical work was published on the 23d of April, and contained so severe and sarcastic a comment on the king’s speech, that his ministers, under the direction of the crown lawyers, determined upon a prosecution: and the home secretary of state, lord Halifax, issued a “general warrant,” i.e. a warrant, in which no particular names were specified, for the apprehension of the authors, printers, and publishers of that paper. As soon as it was discovered that Wilkes had
had given orders for the printing, he was taken into custody, and brought before the two secreries of state. Perfectly self-poifled, and avowing the illegality of his arrest, he refued to answer any interrogatories; and a habeas corpus which had been fued out for him being evaded, he was clofeely confined in the Tower. However, he was soon after brought by habeas corpus before the court of common pleas, when lord chief juftice Pratt declared the opinion of that court against the legality of his commitment, fo that he was difcharged amidit the acclamation of the audience and of the populace. In the course of these proceedings he was deprived of his commiffion as colonel, by the king's order; and his patron, lord Temple, loft his poit of lord-lieutenant of the county. This nobleman, at his own expense, availed himself of the legal decifion againft general warrants, and commenced actions against the king's meffengers, the secrearies, the under secreary, and the folici- tor of the treafury; in all which the profecutors obtained damages, which were paid by the crown, in confequence of an express order of council. Thus the doctrine of the illegality of fuch warrants was establiifhed, and for this accefion to the caufe of liberty the public were indebted to John Wilkes, lord Temple, and lord chief juftice Pratt, afterwards lord Camden. Wilkes, not fatisfied with this triumph, proceeded, againft the advice of friends, to fet up a prefs in his own houfe, and to reprint the North Briton; for which he was again prosecuted to conviction. Having withdrawn to France in 1763, he was expelled from the houfe of commons, because he did not appear to answer the charges that were produced againft him. The next attack that was directed againft him was occasioned by his printing an indecent and profane piece, called "Eflay on Woman," and faid to have been written by Mr. Potter, fon of the abifhop of the fame name; and as fome scandalous reflexions on a bishop were introduced in this piece, complaint of breach of privilege was made in the houfe of lords; and on a profecution, he was found guilty of both the crimes of blasphemy and libel. By his continued abfence, he incurred the penalty of outlawry. Upon a change of ministry he returned to England, and delivered himfelf to cuftody; and confiding in his popularity, he offered himfelf as a candidate to repre- fent the city of London; but failing in this objeft, he was immediately elected for the county of Middlefex. Al- though his fenfence of outlawry was reversed as illegal, he was condemned for his two libels to an imprisonement of 22 months, and a fine of 100l. In 1769 he was charged with being the authour of a pamphlet relating to the riots, occa- fioned by his imprisonement, and expelled from the houfe; and being immediately re-elected, he was declared incapable of a seat in the houfe during the excifing parliament. He now became popular as the farty of liberty, and large fums were collected towards the payment of his debts. He was again re-elected, and his election was declared void. At the next election, the court-candidate, colonel Luttrel, whole votes were about a fourth of thofe of Mr. Wilkes, was de- clared the fitting member. This meafure caufed diffaft- fication and complaint through the country, and produced petitions for the difsolution of parliament. Wilkes, though excluded from parliament, was chosen an alderman of the city of London; and in the excifing of his office as a magiftrate, he refited with his ufual spirit exafciions of authority which he considered as illegal; and actually libelled one of his printers of newfpapers in which the fpeeches of members of parliament were detailed, and who had been arrested by royal proclamation. Two others were released by lord mayor Crofby and alderman Oliver, who being members of the houfe were committed to the Tower. Wilkes was ordered to attend at the bar of the houfe; but in a letter to the speaker, he objefted, that in the order for attendance, no notice was taken of his being a member of the houfe, and his attendance in his place had not been defired, which forms, he faid, were effential: he also demanded his fet, and then he would give a full account and juftification of his conduct. The houfe, fenfible of the difficulty to which it had objefted itfelf, faved its authority by adjourn- ing for the day on which Wilkes was ordered to attend. In 1772 Wilkes was chofen one of the sheriffs for London and Middlefex, and in 1774 lord mayor of London. Having conducted himself with propriety and reputation in his pub- lic offices, he was re-elected in 1776 a reprefentative for the county of Middlefex; and was allowed to take his seat without oppofition. In parliament, he oppofed the meafures that occasioned the American war; and on the accelfion of the Rockingham administration, he carried his motion for refeding the decifion of the houfe of commons, which gave Luttrel a seat by a majority of votes. In 1779 he suc-ceeded in his application for the office of chamberlain in the city of London, and retained it during the remainder of his life. Tired of political conflicts, the latter years of his life paflf off with much notice, fo that, to adopt his own expreffion, he was an "extinguiflied volcano;" and he ex- peired at the houfe of his daughter in 1797, in the 73d year of his age. His private letter affords no memorial that is either amusing or instructive. The early errors of his con- duct call a fhade over his character. His literary talents and attainments, devoted as he was to pleafure, and engaged in bufinesf, never attracted much notice; though as a com- panion he knew how to render himfelf agreeable. Although his patriotism might possibly originate in difappointed views and expectations, he was cofitent and fteady in maintaining the caufe to which he was attached; and he was, either intentionally or incidentally, and by an intrepidity and self-poiflion which he poifioned in an eminent degree, the in- strument of gaining some important advantages to public and private liberty. Alm. Mem. of Wilkes. Ann. Reg. Gen. Biog.

WILKES, in Geography, a town of Ohio, in Gallia county, with 187 inhabitants.—Alfo, a county of the flate of Geor- gia, bordering on South Carolina, containing 7066 inhab- itants. Tobacco is the chief produce, of which 3000 hogheads were exported in 1788.—Alfo, a county in the N.W. corner of North Carolina, with 7247 inhabitants, including 790 slaves.—Alfo, a town of North Carolina; 50 miles W. of Salem.

WILKESBARRE, formerly Wyoming, called also Wilkesburg, a town of Pennsylvania, and chief town of Luzerne county; situated on a plain, bounded on one fide by the Susquehanna, and on the other by a range of mountains, and containing about 150 wooden dwelling-houfes, a church, court-houfe, and gaol, with 1225 inhabitants. A dreadful maffeacre was committed in this place, during the American war, by the Indians under the command of colonel Butler, which is recorded in most histories of that war, and which will ever remain a blot on the English annals. Several of the houfes, to which the unfortunate victims retired to defend them- felves on being refued quarter, are still standing, perfor- rated in every part with balls; the remains of others that were fet on fire are alfo still to be feen, nor will the inhab- itants on any accountuffer them to be repaired. N. lat. 45° 13', W. long. 75° 59'; Weld's Travels, vol. ii.

WILKINS, David, in Biography, a learned antiquary, was born in 1685, and in early life more than once made the tour of Europe, acquiring a knowledge of most modern languages. In 1715 he was appointed by archbishop Wake keeper
keeper of the Lambeth library, of which he made a catalogue, and for his three years' labour in this way he was recommended with several preferments, such as the rectories of Hadley and Monk's Ely, the archdeaconry of Suffolk, and a canonry of Canterbury. Among his principal publications we may reckon "Novum Testamentum Copticum," Oxon, 1716, 4to.; an edition of "Leges Saxoniae ecclesiasticæ et civiles," with many valuable additions, 1721, fol.; "Joannis Seldeni Opera omnia," 1726, 3 vols. fol.; "Pentateuchus Copticus," 1731, 4to.; "Concilii Magne Britanniae," 4 vols. fol. 1736; and a learned preface to bishop Tanner's "Britannico-Hibernica." He married the eldest daughter of Thomas, lord Fairfax, settled in Scotland, and died in 1745, in his 60th year. Nichols's Lit. Anecd. Gen. Biog.

WILKINS, JOHN, D.D., an English prelate, was born near Daventry, in Northamptonshire, in 1624, and finished his education at Magdalen-hall, Oxford, where he graduated M.A. He afterwards took orders, and became chaplain, first to lord Say, and then to Charles, count palatine of the Rhine. At the commencement of the civil war he joined the parliament, took the solemne league and covenant, and became warden of Wadham college. In 1649 he graduated D.D., and in 1656 married the sister of Oliver Cromwell. In 1659 he was nominated head of Trinity college, Cambridge; but being ejected on the restoration of king Charles II., he became preacher to the society of Gray's-Inn, London, and rector of St. Lawrence, Jewry; about which time he was introduced into the Royal Society as fellow and one of the council, and advanced to the fee of Chetter. He was distinguished by his moderation, and was reproached on this account by his enemies, who represented him as wavering in his religious principles. Several bishops cenfured him with uncandid severity, among whom were archbishop Sheldon, bishop Fell, and archbishop Dolben, making no allowance for the favourable disposition which he was led to manifest towards the dissenters by his education under Mr. John Dod, his grandfather, a truly pious and learned man, who disapproved many things in the church of England long before the grand separation which took place on account of Laud's impositions and severities. After the Restoration he was a moderate conformist, and disposed to be indulgent in many things, for the sake of preventing religious divisions. On this account he incurred hatred and obloquy. He at length fell a victim to the flame,occasioned by his fedentary habits, and close application to study; and died, with a tranquillity andfirmnessbecoming a wise man and a Christian, at the house of his friend Dr. Tillotson, in Chancery-lane, London, in November, 1672. Bishop Wilkins was not only an able divine, but a good mathematician and astronomer; and well skilled in mechanics and experimental philosophy. As a writer he was judicious and plain; and he studied more to be useful than to please. Generous in his disposition, he neither sought honour nor riches. The revenues which he received from the church he spent in its service; and while he was secure from want, he did not wish to be richer. His character is thus delineated by Dr. Burnet: "He was a man of as great a mind, as true a judgment, as eminent virtues, and of as good a soul, as any he ever knew; and though he married Cromwell's sister, yet he made no other use of that alliance but to do good offices, and to cover the university of Oxford from the fournefs of Owen and Goodwin. At Cambridge he joined with those who studied to propagate better thoughts, to take men off from being in parties, or from narrow notions, from superfluous conceits, and fierce and rash opinions. He was also a great observer and promoter of experimental philosophy, which was then a new thing, and much looked after. He was naturally ambitious, but was the wiseffel clergyman I ever knew. He was a lover of mankind, and delighted in doing good." He also professed, according to this historian, "a courage which could stand against a current, and against all the reproaches with which ill-natured clergrymen studied to reproach him." His principal works are the following: viz. "The Discoveries of a New World; or, a Discourse tending to prove that it is probable there may be another habitable World in the Moon," London, 1638, 4to., written when he was only twenty-four years of age; "Discourse concerning the Possibility of a Passage to the World in the Moon;" "Discourse concerning a new Planet, tending to prove that it is probable our Earth is one of the Planets," ibid. 1640, 8vo.; "Mercy; or, the Secret Messenger: shewing how a man may with privacy and speed communicate his thoughts to a friend at any distance," ibid. 1641, 8vo.; "Mathematical Magic; or, the Wonders that may be performed by Mechanical Geometry," in two books, ibid. 1648 and 1680, 8vo. These latter five, composing his mathematical works, were printed at London in one volume, 8vo. 1708. "Essay towards a real Character and a Philosophical Language," ibid. 1668, fol.; "Of the Principles and Duties of Natural Religion," in two books, ibid. 1675, 8vo. published by Dr. Tillotson. Also, "Sermons preached on several Occasions," and some others. Life prefixed to his Philosophical and Mathematical Works.

WILKINSON, in Geography, a county of Georgia, with 2154 inhabitants, including 318 slaves.—Alfo, a county of the Missipppi, with 5068 inhabitants, including 2630 slaves.

WILKOMIERS, a town of Lithuanja, in the palatinage of Wilna, on the Swienta, near its union with the Wilna; 44 miles N.N.W. of Wilna.

WILKS, a county of North Carolina, with 9054 inhabitants.

WILKUSCHEK, a town of Prussia; 5 miles N.N.E. of Ragnoitz.

WILL, VOLUNTAS, is usually defined a faculty of the mind, by which it embraces or rejects any thing reprented to it, as good or evil, by the judgment.

Others will have it to be the mind itself, considered as embracing or refusing; adding, that as the understanding is nothing else but the soul, considered as perceiving; so the will is nothing else but the soul, considered as willing, &c.

Mr. Locke more intelligibly defines the will, a faculty which the soul has of beginning or forbearing, continuing, or ending, several actions of the mind, and motions of the body, barely by a thought or preference of the mind, ordering, or as it were commanding, the doing, or not doing, such and such a particular action. This power which the mind has, to order the consideration of any idea, or the forbearing to consider it; or to prefer the motion of any part of the body to its rest, and vice versâ, is what we call the will. See Power.

The actual exercise of that power, is what we call volition, or willing; and the doing or forbearing of any action consequent on such order of the mind, is called voluntary. So far, according to this writer, as a man has a power to think or not to think, to move or not to move, according to the preference or direction of his own mind, so far he is free; and hence liberty, he says, is not an idea belonging to volition or preferring, but to the perfon having the power of doing, or forbearing to do, as the mind shall choose or direct. On the other hand, wherever any performance or forbearance is not equally in a man's power; wherever doing or not doing will
WILL.

will not equally follow upon the preference of his mind; there he is not free, though perhaps the action may be voluntary. Accordingly, where thought is wholly wanting, or the power to act or forbear according to the direction of thought, there necessity takes place; this, in an agent capable of volition, when the beginning or continuation of any action is contrary to the preference of his mind, is called compulsion: when the hindering or stopping of any action is contrary to his volition, it is called restraint. Agents that have no thought, no volition at all, are in every respect necessary agents.

Father Malebranche lays it down, that the will is that to the soul, which motion is to the body; and argues, that as the Author of nature is the universal cause of all the motions in matter, so he is of all the inclinations in the mind; and that as all motions are direct, unless their course be diverted and changed by some foreign cause; so all inclinations are right, and could have no other end but the enjoyment of truth and goodness, were there not some foreign cause to determine the natural impression to evil ends. Accordingly, he defines will to be the impression, or natural motion, which carries us towards good indeterminately, and in the general; and the power the mind has, to direct this general impression towards any particular object that pleases it, is what he calls liberty.

Aristotle distinguishes two kinds of acts of the will, viz. belon to willing, volition: and propriety, election. The first, that employed about the ultimate end; the latter, about the means.

The schoolmen also distinguish the actions of the will into elicit and commanded. Elicit acts, ationes elicitae, are those immediately produced by the will, and really inherent in it; such are willing and willing. Commanded acts, ationes im- perate, are effects produced by other powers; v. gr. the sentient, intellective, or locative powers, at the command or instigation of the will. As to follow, stay, fight, fly, &c.

But others will have the former kind properly to belong to the understanding; and only the latter to the will.

The word will is taken in three senses:

1. For the power or faculty of willing, in which sense it is, we have considered it above.

2. For the act or exercise of this power; as, when we say, No man wills his own destruction.

3. For a habit, or a constant disposition and inclination to do anything, in which sense justice is defined a constant will to give every one what belongs to him: Juftitia est confitans et perpetua voluntas justi faum unicique tribuendi. Inflit. Justin.

WILL, Antecedent. See Antecedent.

WILL, Free. See Liberty, and Freedom.

WILL, Last Will, or Testament, in Law, a solemn act, or instrument, by which a person declares his mind and intention as to the disposal of his goods, effects, &c. after his death. See Testament.

This act or instrument is emphatically styled the will of the deceased, because it directs the disposal of the whole or part of his property, by written or oral instructions properly witnessed and authenticated, according to his pleasure. Some have distinguished between a testament and a will; a will being properly limited to land, and a testament only to chattels, requiring executors, which a will only for land doth not require: so that every testament is a will, but every will is not a testament. However, the words have been commonly used indiscriminately.

WILLS, History of. Wills or testaments, says judge Blackstone, are of very high antiquity. We find them among the ancient Hebrews; not to mention what Eusebius and others have related of Noah's testament, made in writing, and witnessed under his seal, by which he disposed of the whole world, a more authentic instance of the early use of testaments occurs in the sacred writings (Gen. chap. xlvii.), in which Jacob bequeaths to his son Joseph a portion of his inheritance double to that of his brethren; which will we find executed many hundred years afterwards, when the posterity of Joseph were divided into two distinct tribes, those of Ephraim and Manasseh, and had two several inheritances assigned them; whereas the descendants of each of the other patriarchs formed only a single tribe, and had only one lot of inheritance. Solon was the first legislator that introduced wills into Athens; but in many other parts of Greece they were totally discomfited. In Rome they were unknown, till the laws of the Twelve Tables were compiled, which first gave the right of bequeathing; and among the northern nations, particularly among the Germans, testaments were not received into use. Hence it appears, that the right of making wills and disposing of property after death, is merely a creature of the civil state, which has permitted it in some countries, and denied it in others, and subjected it to various restrictions and regulations, where the law allows it.

With us in England, this power of bequeathing is coeval with the first rudiments of the law; not indeed, that it extended originally to all a man's personal estate. See RATIONABILIS parte bonorum.

It is also sufficiently clear, that, before the Conquest, lands were devisable by will. But, upon the introduction of the military tenures, the restraint of devising lands naturally took place, as a branch of the feudal doctrine of non-alienation without the consent of the lord. By the common law of England since the Conquest, no estate, greater than for term of years, could be disposed of by testament; except only in Kent, and in some ancient boroughs, and a few particular manors, where their Saxon immunities by special indulgence subsisted. But when ecclesiastical ingenuity had invented the doctrine of use, as a thing distinct from the land, uses began to be devised very frequently, and the devisee of the use could in chancery compel its execution. However, when the statute of uses, vis. 27 Hen. VIII. cap. 10. had annexed the possession to the use, these uses, being now the very land itself, became no longer devisable; whereupon the statute of wills was made, vis. 32 Hen. VIII. cap. 1. explained by 34 & 35 Hen. VIII. cap. 5. which enacted, that all persons being feigned in fee-simple (except feme-coverts, infants, idiots, and persons of nonfane memory) might by will and testament in writing devise to any other person, except to bodies corporate, two-thirds of their lands, tenements, and hereditaments, held in chivalry, and the whole of those held in fagace; which now, through the alteration of tenures by the statute of Charles II. 12 Car. II. cap. 25. amounts to the whole of their landed property, except their copyhold tenements. As for copyhold and other customary lands, these are devisable or not, according to the custom of the respective manors. And generally, a devise of copyhold will not pass, without a surrender to the use of the will. In the case of a child or widow, a court of equity, in favour of these, will supply a defect of surrender (2 Vez. 582. 5 Vez. 557,); so also, when there is a general devise of real estate to pay debts, and there is no real estate but copyhold: also where a copyhold is in the hands of trustees, the person for whom the lands are held in trust may devise the same without surrender. (4 Atk. 38. 1 Vez. 489.) And though the court will supply the defect of a surrender for the benefit of children, yet the rule doth
doth not extend to grand-children, or to a natural child, and consequently not to any more distant kindred. (2 Vez. 582. 1 Willon, 161. 6 Vez. 544.) And if a man, feized of copyhold lands, surrenders the same to the use of his will, and executes a will, not attested by any witnesses, yet it shall direct the uses of the surrender: for the clause in the statute, which requires the testator’s signing in the presence of three witnesses, is confined only to such devises as pats by the statute of wills of 34 & 35 Henry VIII., which doth not extend to copyhold. (2 Atk. 37. 7 Earl’s Rep. 299.) See Mortmain.

By 29 Car. II. cap. 5, any estate pur auter vie shall be devisable by a will in writing, signed by the party devising the same, or by some other person in his presence and by his express directions, attested and subscribed in the presence of the devisor by three or more witnesses; and if no such devise thereof be made, the same shall be chargeable in the hands of the heir, if it shall come to him by reason of a special occupancy, as affets by descent, as in case of lands in fee-simple; and in case there be no special occupant thereof, it shall go to the executors or administrators of the party who had the devise thereof by virtue of the grant, and shall be affets in their hands.

One that hath money to be paid him on a mortgage may devise this money when it comes. God. O. L. 391.

And if the feoffee in mortgage, before the day of payment which should be made to him, maketh his executors and die, and his heir entereth into the land as he ought; it feemeth in this case, that the feoffor ought to pay the money at the day appointed to the executors, and not to the heir of the feoffee: but yet the words of the condition may be such, as the payment shall be made to the heir; as if the condition were, that if the feoffor pay to the feoffee or to his heirs such a sum at such a day, there after the death of the feoffee, if he dieth before the day limited, the payment ought to be made to the heir at the day appointed. 1 Inst. 209, 210.

And hereby it appeareth, that the executors do more represent the person of the testator, than the heir doth that of the ancestor; for though the executor be not named, yet the law appoints him to receive the money, but so doth not the law appoint the heir to receive the money unless he be named. 1 Inst. 209, 210.

A person may devise by his will the right of presenting to the next avoidance, or the inheritance of an advowson. And if such devise be made by the incumbent of the church, the inheritance of the advowson being in him, it is good, though he die incumbent; for though the tendment hath no effect but by the death of the tementor, yet it hath an inceptive in his life-time: and so it is, though he appoint by his will who shall be presented by the executors, or that one executor shall present the other, or doth devise that his executors shall grant the advowson to such a man. Watf. c. 10.

But where an advowson was devised to the first or other son of B, that should be bred a clergyman and be in holy orders, and if B should have no such son, to C; both devises were held by the court of common pleas to be void, as depending on too remote a contingency; for the rule of law is, that the contingency on which such an executionary devise hinges must take effect within some life in being, or 21 years afterwards; but it was uncertain that the son of B, if he ever should have any, would take, or be able to take orders within 21 years of the death of his father. Proctor v. the Bishop of Bath and Wells, and others, 2 H. Bla. 358.

If upon articles for a purchase, the purchaser die, having devised the land before a conveyance executed, the land will pass in equity; for the testator had an equity to recover the land, and the vendor sold trustee for the tementor, and as he should appoint, till a conveyance executed. 1 Chan. Ca. 39. 2 Vern. 679.

For the vendor of the estate is, from the time of his contract, considered as a trustee for the purchaser; and the vendor, as to the money, is considered as a trustee for the vendor. 1 Atkyns. 573.

So if a man covenant to lay out a sum of money in the purchase of lands, generally; and deviseth his real estate before he hath made such a purchase: the money to be laid out will pass to the heir. Id.

But if a man, having made his will, afterwards contracts for the purchase of lands: the lands contracted for will not pass by the will, but descend to the heir at law. Id.

But if a good title cannot be made of the lands; as the heir in such case cannot have the lands, so he shall not have the money intended to be laid out. Id.

If a man have a lease for ever so many years, determinable upon life or lives, that is, if such or such live so long; this estate may well enough be given and dispofed by will, because it is but a chattel. Went. 19.

A lease for years may also be devised to A for life, remaining to B. And if the lease be renewable, and A renew, B shall contribute to the fine for taking of the benefit of the renewal.

If the testator, by his last will and tendment, do give or bequeath to another any debt due unto him, or a thing in action belonging unto him, the legacy is good and effectual in the law, and may be recovered in this manner, that is to say, if the testator do make the legatary executor of that particular debt or thing in action bequeathed, then the legatary as executor thereof may commence suit in his own name, and recover the same to his own use, against him by whom it was due; but if the testator do not make the legatary executor of the debt or thing in action bequeathed, then his remedy lieth in the ecclesiastical court, where he may convene the executor, and compel him either to sue for that debt in a court competent, and upon recovery and payment thereof to pay it over to the legatary, or else to make a letter of attorney to the legatary for the recovery of the debt or thing in action bequeathed in the name of the executor to the use of the legatary. Swin. 187, 188.

Albeit the testator have no such thing of his own as is bequeathed, yet nevertheless the legacy is good in law; therefore, if the testator do bequeath a horfe or a yoke of oxen, the legacy is good in law, though the testator have neither horse nor ox of his own. But who shall make choice, in this case, of the thing so bequeathed, is a question not to be neglected: and the solution is this; that if the words of the devise be directed to the legatary, as if the testator shall thus say, I will that A B shall have a horse, the choice doth belong to the legatary; but if the words be directed to the executor, as if the testator shall thus say, I will that my executor give to A B a horse, the election doth belong to the executor. Provided nevertheless, that to whomsoever the election doth belong, whether to the legatary, or to the executor, they must not be unreasonable in their election, but frame themselves according to the meaning of the testator; otherwise the legatary might make choice of the best horse in the country, and the executor of the worst, contrary to the meaning of the deceaseth. Swin. 188.

If there be two joint-tenants of lands, and one of them deviseth that which to him belongs, and dieth; this is no good devise, and the devisee takes nothing, because the devise
WILL.

doth not take effect until after the death of the deviseur, and then the surviving joint-tenant takes the whole by prior title, to wit, from the first feoffment. Gilbert on Wills, 120.

And although the jointure is severed before the testator’s death, yet if the will be made before the severance, it will have no effect; unless there is a republication of the will after the partition. Bur. Mansf. 1496.

So also a man cannot give or bequeath by will any of those goods or chattels which he hath jointly with another; for if he should bequeath his portion thereof to a third person, this bequest is void by the laws of this realm; and the survivor, which had those goods or chattels jointly with another, shall have that portion so bequeathed, notwithstanding the said will. Swin. 189.

But otherwife it is with the tenants in common (God. O. L. 131.) and coparceners. For there is no survivor between coparceners, but the part of each is descendible, and consequently may be devised. (Co. Lit. 185. 6.) And a deed of partition is not a revocation of a devise of his moiety by tenant in common. Luther v. Ridley, cited in 3 F. Wms. 160.

By 20 Hen. III. cap. 2. widows may bequeath the crop of their ground, as well of their dowers, as other their lands and tenements; saving to the lords of the fee all such services as be due for their dowers and other tenements. And this is only in affirmation of the common law. (2 Inft. 80.) But by 27 Hen. VIII. cap. 10. a married woman, having a jointure made, shall not have any dowry of the residue of her husband’s lands.

By 28 Hen. VIII. cap. 11. if the incumbent before his death hath caufed any of his glebe land to be manured and fown, at his proper costs and charges, with any corn or grain; he may make and declare his testament of all the profits of the corn growing upon the said glebe land so manured and fown.

But if the testator be leflee for years, and fow the land a short time before his leafe expires, and then dies, before the corn can possibly be ripe within the term, in this cafe a devise thereof is void, because he himself could not, have reapèd it after the expiration of the term, if he had lived. Swin. 191.

Not only that thing may be devised or bequeathed by the testator, which is truly extant, or hath an apparent being at the time of the making of the will or death of the testator; but that thing also which is not in rerum natura, whilst the testator liveth: therefore, it is lawful for the testator to bequeath the corn which will be fown or grow in such foil after his death, or the lambs which shall come of his flock of sheep the next year, depauperizing in such a field. But if there be no such corn growing in that foil, nor any lambs arising out of that flock, then the legacy is defeitute of effect, becaufe no fuch thing is extant at all as was bequeathed. But if the testator devise a certain quantity of grain or number of lambs, as for the purpose, twenty quarters of corn or twenty lambs, and doth will and devise, that the same shall be paid out of the corn which shall grow in such a field, or arise out of his sheep depauperizing in such a ground; though not fo much or no corn at all there grow, or not any or not fo many lambs there arise, yet nevertheless the executor is compellable by law to pay the whole legacies entirely; becaufe the mention of the foil and of the flock was rather by way of demonstration than by way of condition, rather showing how or by what means the faid legacy might be paid, than whether it should be paid at all yea or no. Swin. 186.

Those things which after the death of the testator defend to the heir of the deceafed, and not to his executor, cannot be devisèd by testament, except in fuch caíes wherein it is lawful to devise the lands, tenements, or hereditaments.

If a man be seiz’d of a house, and possessed of divers heir-looms, that by custom have gone with the house from heir to heir, and by his will deviseth away thefe heir-looms; this devise is void; for the will taketh effect after his death; and by his death, the heir-looms by ancient custom are vested in the heir, and the law prefers the custom before the devise. And fo it is, if the lord ought to have a heiriot against his tenant, and the tenant deviseth away all his goods; yet the lord shall have his heiriot for the reason aforesaid. 1 Inft. 185.

The testator may devise all goods and chattels which he hath in his own right, but not those which he hath in the right of another as executor. Swin. 185.

An administrator cannot make a testament of those goods which he hath as administrator to any person dying intestate; because he hath not any such goods to his own proper use, but ought therewithal to pay the debts of the dead person, and to distribute the rest according to law. Swin. 189.

The husband cannot devise fuch goods as his wife hath as being executeur to another, nor fuch things as are in action, as debts due to her before marriage by obligation or contract, unless he and his wife recover the fame during marriage, or that he renew the bonds, and take them in his own name; otherwise after his death they remain to her. 1 Inft. 351.

But the husband may, at any time during the couverture, release a bond given to his wife. And where the husband makes a settlement, the bonds to his wife, being part of her fortune, will notwithstanding his death in the life-time of his wife, before the security be changed, be decreed in equity to his executor; he being considered in that cafe as a purchafer for a valuable consideration. Cafes in the time of L. Tabl. 168.

A man may by his will dispose of his chattels and personal estate that he shall for the future acquire, any time after the making his will, to the time of his death. And this is necessary from the reason of the thing; because the chattels and personal estate are in a continual fluctuation; and if the law were not fo, it would create very great confusion, or else would render it unnecessary for a man to make a new will every day. Gilb. 122.

But it is not so with lands, for they are fixed and permanent: and, therefore, if a man maketh his will, and deviseth therein all the lands which he shall have at the time of his death; and after that, he purchaseth lands, and dieth without republication or making a new will; in this case, though his intent to the contrary is very apparent, yet it is a void devise: for a man cannot devise any lands but what he hath at the time of making his will. And this was adjudged upon great deliberation, by Holt chief justice and the court, in the cafe of Bunker and Cook: and the judgment was affirmed afterwards upon a writ of error in the house of lords, Feb. 24, 1707. Gilb. 122.

But, by Holt chief justice: If he republished his will, in such manner, as well as such circumstances, as are necessary to complete execution of an original will; then the purchased lands will pass as by an original will. (11 Mod. 127.) And in truth this seeming to make it a new will, to all intents and purposes; and not a republication of the old one.

But a codicil, which concerneth only personal legacies, will not amount to a republication of the will, fo as to pass lands purchased after the making of the will. 2 Vern. 625.
WILL.

If a man devieth all his lands for payment of his debts, and purchaseth lands afterwards: the lord keeper faid he would decree a sale, though there were no precedent articules.

2 Cha. Ca. 144.

If a man hath a lease, and dispofeth of it specifically by his will; and after surrenders it and takes a new leave, and after dies; the devisee shall not have this last leave, because this was a plain countermand of his will. Goldf. 93.

But in the case of Sterling and Lydiard, Nov. 21, 1744, where a man devised all and singular his leafhold estate, goods, chattels, and personal estate whatsoever, and afterwards renewed a leave; it was held by the lord chancellor Hardwicke clearly, that the leafhold estate paffed by the will.

If a man devieth a term for years, which he hath not at the time of the devise, but purchaseth some time before his death; Holt chief justice doubted whether this would be good. But Mr. Peere Williams says, that notwithstanding the doubt which the court of king's bench seems to have had in that case, it hath been clearly held to pass by such a will. 3 P. Wms. 169.

WILLS, Persons capable of making. Every person hath full power and liberty to make a will, that is not under some special prohibition by law or custom: which prohibitions are principally upon three accounts; for want of sufficient libration; for want of sufficient liberty and free will; and on account of criminal conduct.

In the first class are to be reckoned infants, under the age of fourteen if males, and twelve if females; which is the rule of the civil law. By statute 34 & 35 Hen. VIII. cap. 5. wills or testaments made of any dames, lands, tenements, or other hereditaments, by any person within the age of twenty-one years, shall not be taken to be good or effectual in law; for until that time, by the common laws of this realm, they are accounted infants. (Swinb. 74.)

But by custom in particular places, they may devise lands before the age of twenty-one. (Gom. L. 21. Wentw. 24.) But no custom of any place can be good, to enable a male infant to make any will before he is fourteen years of age. (Law of Exec. 153.) If the testator is not of sufficient discretion, whatever be his age, that will overthrow his testament. Accordingly, madmen, or otherwise non competes, idiots or natural fools, person known childishly by age or delirium, such as have their senses betossed with drunknness; all these are incapable, by reason of mental disability, to make any will as long as such disability lasts. To this class may also be referred such persons as are born deaf, blind, and dumb; who, as they have always wanted the common inlets of understanding, are incapable of having animus testandi, and their testaments are therefore void. It has been maintained that persons deaf and dumb, who understand what a testament meaneth, and that are defirous of making one, may by signs and tokens declare their testament; and that a blind person may make a nuncupative testament, by declaring his will before a sufficiency number of witnesses; and that he may make his testament in writing, provided the same be read before witnesses, and in their presence acknowledged by the testator for his last will. (Swinb. 95, 96.

Persons of the second description are by the civil law of various kinds; as prisoners, captives, and the like. But the law of England does not make such persons absolutely intellible; but only leaves it to the discretion of the court to judge, upon the consideration of their peculiar circumstances of dures, whether they could be supposeth to have liberum animum testandi. With regard to feme-covets, our laws differ still more materially from the civil. Among the Romans, a married woman was as capable of bequeathing as a feme-fole. But with us, a married woman is not only utterly incapable of devising lands, being excepted out of the statute of wills, 34 & 35 Hen. VIII. cap. 5. but also she is incapable of making a testament of chattels, without the licence of her husband, who frequently, upon marriage, covenants with her friends to allow her that licence; his assent, therefore, must be given to the particular will in question, without which it will not be a complete testament. Her will, therefore, operates in the nature of an appointment, the execution of which the husband by his bond, agreement, or covenant, is bound to allow. The queen-confect is an exception, for the may dispof of her chattels by will, without the consent of her lord; and any feme-covert may make her will of goods, which were in her possession in auter droit, as executrix or administratrix; for these can never be the property of her husband; and if she has any pin-money or separate maintenance, it is said she may dispof of her savings thereout by testament, without the control of her husband. But if a feme-lole makes her will, and afterwards marries, such subsequent marriage is effeemed a revocation in law, and entirely vacates the will.

Persons of the third class are, first, all traitors and felons, from the time of conviction; for then their goods and chattels, and all such lands, tenements, and hereditaments, as they shall have in their own right, nse, or possession, of any estate or inheritance, at the time of such treason committed, or at any time after, are forfeited to the king. The testament before made doth, by reason of the same conviction, become void both in respect of goods, and also in respect of lands, tenements, and hereditaments. But if a person, attainted of treason, obtain the king's pardon, and be thus restored to his former estate, he may make his testament, and his former testament is good. (Swinb. 97.) Neither can a feo de je make a will of goods and chattels, for they are forfeited by the act and manner of his death; but he may make a devise of his lands, for they are not subjected to any forfeiture. (3 Inf. 55.) Outlaws also, though only for debt, are incapable of making a will, so long as the outlawry subsists, for during that time their goods and chattels are forfeited; but he that is outlawed in an action personal, may make his testament of lands, for they are not forfeited. (Swinb. 107.) An outlaw in a personal action may in some case make executors; for he may have debts upon contract, which are not forfeited to the king; and those executors may have a writ of error to reverse the outlawry. (Cru. Eliz. 851.) Coke observes, that an excommunication (meaning the greater excommunication) is worse than an outlawry; for if a plaintiff, who is an executor, be outlawed, his outlawry cannot be pleaded to disbar him from proceeding in the suit, because it is in the right of another; but if he is excommunicated, it is otherwise, because every man that converses with such a person is excommunicated himself (1 Inf. 134.); that is, after he is denounced excommunicate, and they are admonished not to converse with him. (Ayl. Par. 266.) As for perons guilty of other crimes, short of felony, who are by the civil law precluded from making testaments, (as usurers, libellers, and others of a worfe stamp,) by the common law their testaments may be good.

WILL, Nature and Incidents of a. Wills or testaments are divided into two sorts, viz. written and verbal or nuncupative: of which the former is committed to writing; the latter depends merely upon oral evidence, being declared by the testator in extremis before a sufficient number of witneses, and afterwards reduced to writing. A codicil is a supplement to a will.
As _nuncupative_ wills and codicils are liable to great im-
positions, and may occasion many perjuries, the statute of
frauds, 29 Car. II. cap. 3, hath laid them under many restric-
tions; except when made by mariners at sea, and sol-
diers in actual service. As to all other persons, it enacts,
1. That no will shall be revoked or altered by a sub-
sequent nuncupative one, except the same be in the life-
time of the testator reduced to writing, and read over to him and
approved; and unless the same be proved to have been so
done by the oaths of three witnesses at least; who, by 4 &
5 Ann. cap. 16, must be such as are admissible upon trials
at common law.

2. That no _nuncupative_ will shall be good, where the
estate bequeathed exceeds 30l, unless proved by three such
witnesses, present at the making of it, and unless they or
some of them were specially required to bear witness to it
by the testator; and unless it was made in his last sicknes,
in his own habitation, or where he had previously resided
at least ten days, except he be surprised with sickness on a
journey, or from home, and dies without returning to his
dwelling.

3. That no _nuncupative_ will shall be proved by the wit-
nesses after six months from the making, unless it were put
in writing within six days; nor shall it be proved till four-
teen days after the death of the testator, nor till procès
hath first issued to call in the widow, or next of kin, to
contest if they think proper.

As to _written_ wills (viz. those that concern not the de-
vise of lands), they need not any witnesses of their publication.
A testament of chancellors, written in the testator’s own hand,
though it has neither his name nor seal to it, nor witnesses
present at its publication, is good; provided sufficient proof
can be had that it is his hand-writing. (Swib. 353-
Gilb. Rep. 262.) And though written in another man’s
hand, and never signed by the testator, yet if proved to be
according to his instructions, and approved by him, it hath
been held a good testament of the personal estate. How-
ever, it is the safer and more prudent way, and leaves lefs
in the breath of the ecclesiastical judge, if it be signed or
sealed by the testator, and published in the presence of wit-
nesses. It is said in 3 Salk. 396, that by the canon law,
and also by the common law, two witnesses are requisite to
prove a will of goods; for one witness by the civil law, unto
which the other laws are conform in this matter, is as no
witnesses at all. 1 P. Wms. 13.

The statute of frauds and perjuries, 29 Car. II. cap. 3,
directs, that all devises of lands and tenements shall not only be
in writing, but signed by the testator, or some other per-
son in his presence, and by his express direction; and be
subscribed, in his presence, by three or four credible wit-
nesses. In the construction of this statute, it has been ad-
judged that the testator’s name, written with his own hand
at the beginning of his will, as “I John Mills do make this
my last will,” &c. is a sufficient writing, without any
name at the bottom; though the other is the safer way.
(3 Lev. 1.) It hath been said, that if the testator only
put his seal to the will, without signing it, this is a sufficient
writing within the statute; because signing is no more than
a mark to distinguish a man’s act, and sealing is a sufficient
mark to know it to be his will. (Gilb. 93.) Others,
however, have held that sealing without signing was not
sufficient. (1 Wilfon, 313. 2 Vezey, 459.) Signing
being only mentioned in the statute, sealing is not necessary.
(God. O. L. 5. 1 Wentw. 29.) It has also been deter-
mined, that though the witnesses must all see the testator
sign, or at least acknowledge the signing, yet they may do
it at different times. But they must all subscribe their
names as witnesses in his presence, lest by any possibility
they should mistake the instrument. In one case determined
by the court of king’s bench, the judges would not allow
any legatee, nor consequently a creditor, where the legacies
and debts were charged on the real estate, to be a com-
petent witness to the devise. This determination occasioned
the statute 25 Geo. II. cap. 6, which restored both the
competency and credit of such legatees, by declaring void
all legacies given to witnesses, and thereby removing all
possibility of their interest affecting their testimony. The
same statute likewise established the competency of creditors,
by directing their testimony to be admitted; but leaving
their credit (like that of all other witnesses) to be con-
sidered, on a view of all the circumstances, by the court
and jury before whom such will shall be contested. And in
a much later case, M. 31 Geo. II. the testimony of three
witnesses, who were creditors, was held to be sufficiently
credible, though the land was charged with the payment of
debts. By 48 Car. II. cap. 3, all declarations or
creations of trusts or confidences, of any lands, tenements,
or hereditaments, shall be manifested and proved by some
writing signed by the party who is by law enabled to de-
clare such trust, or by his last will in writing, or else they
shall be utterly void, and of none effect. And all grants
and assignments of any trust or confidence shall likewise be
in writing, signed by the party granting or assigning the
same by such last will or devise; or else shall be utterly
void, and of none effect.

No testament is of any effect till after the death of the
testator; and, therefore, if there be many testaments, the
last overthrows all the former; but the republication of a
former will revokes one of a later date, and establishes the
first again. Although no man can die with two testaments,
because the latter doth always infringe the former; yet a
man may die with divers codicils, and the latter doth not
hinder the former, so long as they be not contrary. (Swib. 15.)
All codicils are part of the will; therefore, a codicil
merely for a particular purpose, as to change an executor,
and confirming the will in all other respects, does not revive
a part of the will revoked by a former codicil. If two
testaments be found, and it doth not appear which was the
former or latter, both testaments are void; but if two
codicils be found, and it cannot be known which was the
first or last, and one and the same thing is given to one per-
son in one codicil, and to another person in another codicil,
the codicils are not void, but the persons therein named
ought to divide the thing between them. Swib. 15.

If codicils are regularly executed and attested, they may
be proved as wills are. So if they are found written by the
testator himself, they ought to be taken as part of the will,
and to be proved in common form by the oath of the ad-
ministrator with the will annexed; and in case of opposition,
by witnesses to the hand-writing and finding; and it hath
been usual to exhibit an affidavit of the hand-writing and
finding, before a probate or administration passes even in
common form.

But in case of a real estate, a codicil cannot operate, unless
it be executed according to the statute. 1 Aik. 426.

By 48 Car. II. cap. 3, no devise in writing of lands,
tenements, or hereditaments, or any clause thereof, shall be
revocable, otherwise than by some other will or codicil in
writing, or other writing declaring the same, or by burning,
cancelling, tearing, or obliterating the same by the testator
himself, or in his presence, and by his directions and confent;
but all devises and bequests of lands and tenements shall re-
main and continue in force, until the same be burnt, can-
celled, torn, or obliterated by the testator, or by his direc-
tions.
tions in manner aforesaid, or unless the same be altered by some other will or codicil in writing, or other writing of the devisor, signed in the presence of three or four witnesses declaring the same.

And no will in writing concerning any goods or chattels or personal estate shall be repealed, nor shall any clause, devise, or bequest therein be altered or changed, by any words, or will by word of mouth only, except the same be in the life of the testator committed to writing; and after the writing thereof read unto the testator, and allowed by him, and proved to be so done by three witnesses at the least.

A will which will pass personal estate is not a sufficient revocation of a former will, by which a real estate is devised. Comyns, 451.

Although the statute says, that no will in writing concerning personal estates shall be repealed by word of mouth only, except the words be put into writing, and read to and allowed by the testator, and proved to be so done by three witnesses; yet where a man by will in writing devised the residue of his personal estate to his wife, and the dying, he afterwards by a nuncupative codicil bequeathed to another all that he had given to his wife, this was resolved to be good: for by the death of the wife, the devise of the residue was totally void; and the codicil was no alteration of the former will, but a new will for the residue. 1 Abr. Ca. Eq. 408.

Also, the statute hath not taken away revocations of wills by act of law; as if the testator afterwards make a feoffment, or do any other act inconsistent with the will: but such revocation remains as before the statute. Carth. 81.

If a man devises lands to one and his heirs, and afterwards mortgages the same lands to another for years or in fee; though a mortgage in fee is a total revocation at law, yet in equity it shall be a revocation pro tanto only. 1 Abr. Ca. Eq. 410.

And the reason is, because a mortgage is not considered as a conveyance of the estate, but only as a charge upon it; being merely a security, and in the consideration of equity carries only a chattel interdict, the creditor gains nothing real, it affords no dower, and goes to executors. Sparrow and Hardcastle, May 6, 1754. 3 Atl. 798.

But if lands be devis'd to one in fee, and afterwards mortgaged to the same devisee; this is a revocation in toto, being inconsistent with the devise: but if the mortgage had been to a stranger, it had been a revocation quoad the mortgage only. Prec. Ch. 514.

If a man seised in fee devises it to one in fee or for life, and afterwards makes a lease to another for years; this, even at law, shall not be a revocation but during the years. 1 Roll's Abr. 616.

So if a husband poissessed for forty years devises it to his wife, and after leases the land to another for twenty years, and dies; this lease is not any revocation of the whole estate, but only during the twenty years, and the wife shall have the residue by the devise. Id.

But where a man seised of a lease for lives devises it, and afterward surrendered the old lease, and took a new one to him and his heirs for three lives; it was decreed, that this renewal of the lease was a revocation of the will as to this particular. For by the surrender of the old lease, the testator had put all out of him, had divested himself of the whole interest; so that there being nothing left for the devise to work upon, the will null and, the new purchase, being of a freehold descendable, could not pass by a will made before such purchase. 3 P. Wms. 166. 170.

But where the testator devised all and singular his leasehold estate, and afterwards renewed a lease; it was held by lord Hardwicke clearly, that this leasehold estate pass'd by the will: for that this is not a specific legacy, but only an enumeration of the several particulars of the personal estate, but yet is a general devise of the whole. 3 Atl. 199.

Though a covenant or articles do not at law revoke a will; yet if entered into for a valuable consideration, amounting in equity to a conveyance, they must concludingly be an equitable revocation of a will, or of any writing in nature thereof. 2 P. Wms. 642.

A woman's marriage is alone a revocation of her will. Id.

A man made a will, and appointed one (who was no relation) to be his executor. He afterwards went abroad, where he became a governor of one of the plantations, and went over for an English woman of his acquaintance, whom he married, and had children by; and died, without an actual revocation of his will. Yet it was determined, that this total alteration of his circumstances was an implied revocation. 1 P. Wms. 304.

It is an established maxim, that wills should be construed favourably. Accordingly, the intention of the testator is called by lord Coke the polar-star, to guide the judges in the expounding of wills. In divers instances, relating to the interpretation of wills, collateral evidence hath been admitted in the court of chancery to explain the testator's intention. But notwithstanding these cases, the courts have been very unwilling to admit of parol evidence in relation to any thing that appears on the face of a will; and it is certain that too much caution cannot well be used in this particular, especially when it is considered that the statute of frauds and perjuries, which was made to prevent perjury, contrariety of evidence, and uncertainty, binds the courts of equity as well as the common-law courts; as also that little regard ought in many cases to be had to the expressions of the testator, either before or after the making his will, because possibly these expressions might be used by him, on purpose to conceal or disguise what he was doing, or to keep the family quiet, or for other secret motives and inducements which cannot after his death be found out. 2 Bac. Abr. 310.

Notwithstanding that wills are generally favoured by the law; yet where the testator endeavours to establish a settlement against the reason and policy of the common law, the judges will reject it. Gilb. 110. 2 Bac. Abr. 79.

Also where the testator by his will maketh no other disposition of his estate than the law itself would have done, had he been silent; there such a will is useless, and shall be rejected: and, therefore, if a devise be made to a person and his heirs, which person is heir at law to the devisor; this is a void devise, and the heir shall take by descent as his better title; for the devisee strengthens his title, by taking away the entry of such as may possibly have right to the estate; whereas if he claims by devise, he is in as by purchase. Gilb. 110. 2 Bac. Abr. 79.

Also devises are void and rejected, where the words of the will are so general and uncertain, that the testator's meaning cannot be collected from them; and, therefore, where a man by will gave all to his mother, the general words did carry no lands to his mother; for since the heir at law hath a plain and uncontested title, unless the ancestor divinherits him, it would be severe and unreasonable to fet him aside, unless such intention of the testator is evident from the will; for that were to fet up and prefer a dark and at best but a doubtful title to a clear and certain one. Gilb. 112. 2 Bac. Abr. 81.

The clause of "perfect mind and memory" is more usual than necessary in a will, and yet not hurtful. (Swinb. 7.) But
WILL.

But in case of contellt, it is necessary to prove the sanity of the testator. 2 Atk. 56.

For the different modes of devise, and the legal meaning of the appropriate terms by which they are expressed, we refer to Burn’s Ecclesiastical Law, ubi infra.

From the above accounts it follows, that testaments may be avoided three ways: 1. If made by a perfon labouring under any of the incapacities before mentioned. 2. By making another testament of a later date. And, 3. By cancelling or revoking it.

The Romans were wont to set aside testaments, as being inofficiales, deficient in natural duty, if they disinterested or totally passed by (without assigning a true and sufficient reason) any of the children of the testator. But if the child had any legacy, though ever so small, it was a proof that the testator had not left his memory nor his reason, which otherwise the law presumed. Hence probably, says Blackstone, has arisen that groundless vulgar error of the necessity of leaving the heir a shilling or some other express legacy, in order to effectually disinherit him; whereas the law of England, though the heir or next of kin be totally omitted, admits no quareia inofficiales, to set aside such testament.


Wills of Seamen and Marines. By the statute 26 Geo. III. c. 63, no will made by any petty officer or seaman in the king’s service, whereby any wages, pay, prize-money, or allowance of money of any kind due for such service is bequeathed, shall be valid, unless, if made while the party is in the service, it be signed before and attested by the captain, or the officer then commanding, and one of the signing officers of the ship to which the party belongs, and unless it specify in the body thereof the name of the ship, and the number at which the maker of the will立unds upon the ship’s books, and contains a full description of the reference, profession, or business of the person in whose favour it is made, and the day of the month and the place where it was executed, or by the agent of any of his majesty’s hospitals or quarters appointed to receive sick and wounded seamen, in which the party may be at the time; or if made by such officer or seaman discharged from the service, within the bills of mortality, unless it be attested by the officer appointed by the treasurer of the navy to inspect such wills, or if made at any of the ports where seamen’s wages are paid, unless it be attested by the treasurer of the navy, chief or second clerk there; or if made at any other place, unless it be attested by the minister and churchwardens of the parish in England or Ireland, or by two elders of the parish in Scotland. In order to obtain a probate thereof, the will must be sent to a proctor by the inspector of wills appointed by the treasurer of the navy.

If any such petty officer or seaman should die intestate, the peron claiming administration must apply by petition to the said inspector, who is to grant a certificate directed to a proctor, that letters of administration may pass in favour of the petitioner, if entitled thereto by law.

If any proctor, registrar, or other officer of any ecclesiastical court shall be aiding and abetting in procuring probate of a will, or letters of administration, for the purpose of enabling any peron to receive such wages, pay, prize-money, or allowance of money of any kind, without first obtaining the certificate from the inspector of seamen’s wills, or peron authorized to officiate for him, every such proctor, registrar, or other officer, shall forfeit 500l., and for ever after be incapable of acting in any capacity in any ecclesiastical court in Great Britain or Ireland.

And by the 32 Geo. III. c. 34. after the 1st day of Au-
gust 1792, no letter of attorney or will of a non-commissioned officer of marines or marine shall be valid unless made according to the 26 Geo. III. c. 63.

All are to be deemed petty officers, seamen, marines, &c. except such as are rated upon the books of such ship, admirals or flag officers, and their secretaries, captains, and lieutenants, masters, second masters, and pilots, physicians, surgeons, chaplains, boatswains, gunners, carpenters, and purlers, captains of marines, captain lieutenants of marines, lieutenants, and quarter-masters of marines.

Every lieutenant, on board any of his majesty’s ships, shall upon a page of every mutter book of such ship sign his name for the purpose, and for the purpose only, that the inspector of seamen’s wills, or such person as shall be appointed by him, may have an opportunity of comparing the name with the name of any such lieutenant attesting the will, &c. executed by or in favour of any petty officer, seaman, non-commissioned officer of marines or marine.

And all captains of ships shall, upon their monthly mutter books or returns, specify which of the men, mentioned in the said returns, have granted or issued any will or testament during that month or space of time from the preceding returns, by inferting the date thereof opposite to the party’s name. The mutter books, &c. in case of failing from any foreign station, at a time when no opportunity shall offer of transmitting them to the navy-board, to be left with the naval officer of the place, if any, or with some respectable merchant, with directions to forward the same to the commissioners of his majesty’s navy by the first safe opportunity, and in case of the removal of the commander, to be delivered over to his successor and a receipt given for the same.

Provided that it shall be lawful for the minister of any parish, to whom the inspector of seamen’s wills shall transmit his check of any letter of attorney or will, passed and allowed by him, to deliver the said check to the attorney or executor in the said letter of attorney or will named and appointed. And all seamen’s letters of attorney, and wills made prior to the 1st of Augst 1786, and those of marines prior to the 1st of Augst 1792, shall be examined and inspected by the inspector of seamen’s wills for the purpose of preventing frauds, forgeries, or impositions of any kind therein; and if such inspector shall fee no cause to suspend the authenticity of the same, he shall affix the stamp of his office, and issue checks for the same, but if he shall fee good cause to suspend the truth and authenticity of such letter of attorney or will, he shall report the same to the treasurer, or to the paymaster of the navy, and shall enter his caveat against such letter of attorney or will, which shall prevent any money from being had or received thereof until the same shall be authenticated to the satisfaction of the said treasurer or paymaster.

The wages, pay, prize-money, or allowances of petty officers or seamen, non-commissioned officers of marines, and marines dying intestate, are to be paid only upon letters of administration obtained in the following manner:

The person claiming such administration shall fend or give in a note or letter to the inspector of seamen’s wills, flating the name of the deceased, the name of the ship or ships to which he belonged, and that he has heard or been informed of his death, and requiring the inspector to give such directions as may enable him to procure letters of administration to the deceased, or to the like effect, upon receipt whereof the inspector of seamen’s wills shall deliver or send to the person claiming such administration, a paper in a peculiar form of words, which paper being duly filled up and certified shall be returned to the treasurer, or to the paymaster of his majesty’s navy, London, who upon receiving the
the same shall direct the inspector of seamen's wills to examine the same, and make such inquiry relative thereto as may appear to him necessary on that behalf; and being satisfied, he shall forthwith make out a certificate for obtaining letters of administration, and pursue the course minutely described in Burn's Ecclesiastical Law, art. Will.

By 32 Geo. III. c. 34, the following sums are to be paid for the seal, parchment, writing, and finishing forth of probates of wills and letters of administration granted in pursuance of this act, for the purpose of receiving wages, or pay, or allowances of money of any kind, which shall remain due to the deceased, viz.

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<td>For probates of wills, if the goods and chattels are under the value of 20l.</td>
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<td>For commissions or requitions to swear executors or administrators:</td>
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<td>Under 20l.</td>
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But if the probates or letters of administration be granted to the widow, children, father, mother, brother, or sister, in pursuance of this act, for the same purpose of receiving wages, or pay, or allowances of money of any kind, which shall remain due to such warrant or petty officer, &c. then the following sums are to be paid, viz.

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<tr>
<td>For probates of wills under 20l.</td>
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<td>For probates of wills under 100l.</td>
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And no more than 5l. are to be taken for the suing forth of the probate of any will or letters of administration granted to the widow, children, father, mother, brother, or sister of any such seaman or marine, &c. and 5l. for commissions or requitions to swear such widow, &c. unless the goods amount to 100l.: which half-mentioned charge of 5l. must be understood to be demandable where the probate or letters of administration are not for the purpose of receiving wages, or pay, or allowances of money remaining due, but for general purposes, as to obtain administration of the goods and chattels of the deceased.

A bill of the expenses of obtaining letters of administration to creditors, is to be laid before and taxed by one of the registrars of the prerogative court of Canterbury, or their deputies, who are entitled to a fee of 3l. 4d. for the same; and the proctor is to transmit such letters of administration with the bill of expenses so certified, to the treasurer or paymaster of his majesty's navy. Proctors taking more than the preferred sums forfeit 50l., and registrars and other officers of any ecclesiastical court, procuring letters of administration or probate contrary to this act and the 26 Geo. III., to be incapacitated to act, and forfeit 500l.

WILL, Qualification and Office of the Executor of a. See Executor, Executor de Jure Tort, and Joint-Executors. See also Debts, Debtor-Executor, Inventory, and Legacy.

WILL, Probate of a. See Probate.

WILL, Estrate at, in Law, is where lands and tenements are let by one man to another, to have and to hold at the will of the lessor; and the tenant by force of this lease obtains possession. Every estate of this kind is at the will of both parties, landlord and tenant: so that either of them may determine his will, and quit his connection with the other at his own pleasure, under certain restrictions. For, if the tenant at will fows his land, and the landlord, before the corn is ripe, or reaped, puts him out, the tenant shall have the emblements, and free ingrefs and egress to cut and carry away the profits. But where the tenant himself determines the will, the landlord shall have the profits of the land. The law is careful, that no such sudden determination of the will by one party shall tend to the manifest and unforeseen prejudice of the other. This appears in the case of emblements put mentioned; and also, the lease after the determination of the lessor's will shall have reasonable ingrefs and egress to fetch away his goods and utensils. And if rent be payable quarterly or half-yearly, and the lessor determines the will, the rent shall be paid to the end of the current quarter or half-year. Upon the same principle, courts of law have of late years inclined as much as possible against construing demises, where no certain term is mentioned, to be tenancies at will: but have rather held them to be tenancies from year to year, so long as both parties please, especially where an annual rent is referred: in which case they will not suffer either party to determine the tenancy even at the end of the year, without reasonable notice to the other. Blackl. Com. vol. ii.

WILL, with a Whisp. See Ignis Fatuus.

WILL'S CREEK, in Geography, a creek on the N.E. coast of the island of St. Christopher, to the S.W. of Muddy Point.

WILL'S CREEK, a river of Maryland, which runs into the Potomack, N. lat. 39° 30'. W. long. 78° 47'.

WILLACH. See Villach.

WILLAERT, Adrian, in Biography, the disciple of John Mouton, and master of Zarlin, has been long placed at the head of the Venetian school of counterpoint by the Italians themselves. He was born at Bruges in Flanders, and during his youth studied the law at Paris; if with the view of making it his profession, there must have been an early conflict between legislation and music, which having a powerful advocate in his own heart gained the cause; for by his own account (see Josquin) he went to Rome in the time of Leo X., where he found that his motet, "Verbum bonum et suave," was performed in the pontifical chapel, as the work of that renowned composer; he therefore must have been a contrapuntist some time, before any of his works could have travelled to Rome.

The account which Zarlin gives of this motet (P. i. p. 175.) having palled for a work of Josquin, excited our curiosity to see it; and finding it among the Motetti della Corona, in the British Museum, we feared it; but discovered that the predilection for a great name had operated too powerfully in favour of this composition while Josquin was imagined to be the author of it; for it is neither written with the clearness, dexterity, nor even correctness of that wonderful contrapuntist: there is not only confusion in the
the parts and design, in many places, but something very harsh and unpleasing in the harmony, particularly in the closers without a sharp seventh, both in the key-note and in the fifth. The motet is in fixed parts, sopranos, two counter- tenors, tenor, baritone, and bafe. Some of these sevens would doubtless have been made sharp in performance by the finger of those times, in obedience to a rule for sharpening ascending sevens in minor keys, and flattening them in defcending.

The list of his works, in Walther's Dictionary, though ample, is far from complete. The motet Verbum bonum, just mentioned, was published at Fosfombrone in 1519, forty- three years before Zarlin made him an interlocutor in his dialogue (Ragionamente), at Venice; and it can hardly be imagined that no others of his compositions appeared till 1542, when, we are told, that his motets for fix voices were published. In the Flor di Motetti, lib. 1, Venice, 1539, there is a Pater-noster, in four parts, by Adrian; and in the same year the first book of his motets, for four voices, was republished in the same city. by Ant. Gardano, in folio, under the following pompous title: "Famofifimi Adriani Willaert, Chori Divi Marii illufrifsimi Reipublicae Venetiarum Magiftri, Mufica Quatuor Vocum (quæ vulgo Motetica nuncupatur) novior omní iudio, ac diligentia in lucem edita." This edition, which, we find by the title, was not the first, is preferred in the British Museum. Indeed, for near fifty years after his name first appeared, hardly a collection of motets or madrigals was published to which he did not contribute; but the most splendid and curious work of this author, that we have seen, is preferred in the British Museum. It was published at Ferrara, 1558, by his scholar and friend, Francesco Viola, another of the interlocutors in Zarlin's Ragionamente, under the title of Mufica Nova, in three, four, five, fix, and seven parts. In the dedication of this work to Alfonso d'Este, duke of Ferrara, the editor, his maestro di capella, calls Adrian (the name by which he is always mentioned by the Italians) his master, and says, that he is strongly attached to him, not only for his wonderful abilities in music, but integrity, learning, and the friendship with which he has long honoured him. Zarlin, in like manner, omits no opportunity of exalting the character of his master. These are honourable testimonies of regard, which seem the more worthy of being recorded, as, either from the worthlessness of the master, or ingratitude of the scholar, they are but seldom bestowed.

In the canzon part there is a wooden cut of the author: "Adrian Willaert Flandr. Effigies." And indeed the compositions are of that kind for which he was most renowned, and such as the editor thought would constitute the most durable monument of his glory. In the tenor part there are many canons of very curious construction; some with two and three clefs, and a different number of flats and sharps for the several parts, which are moving in different keys at the same time; and one particularly curious, in seven parts, "Præter rerum fieriem," of which three are in strict canon of the fourth and fifth above the guide; the tenor leading off in C, the fustus following in C, and the femina pars in D, while the rest move in free fugue.

Zarlin (P. iii. p. 268.) affirms to Adrian the invention of pieces for two or more choirs; and Pecetoni (Guida Armonica) says, that he was the first who made the bates in compositions of eight parts, move in unisons or octaves; particularly when divided into two choirs, and performed at a distance from each other, as they had occasion for a powerful guide. The dexterity and resources of this author, in the construction of canons, are truly wonderful, as is, indeed, his total want of melody; for it is scarcely possible to arrange musical sounds, diatonically, with less air or meaning, in the single parts. But there are many avenues through which a musician may travel to the temple of Fame; and he that pursues the track which the learned have marked out, will perhaps not find it the most circuitous and tedious; at least theorists, who are the most likely to record the adventures of passengers on that road, will be the readiest to give him a chart. A learned and elaborate style conceals the want of genius and invention, more than the free and fanciful productions of the present times.

Adriano lived to a great age, and filled a very high musical station, maestro di capella of St. Mark's church at Venice. His works and scholars were very numerous; and among those to whom he communicated the principles of his art, there were several who afterwards arrived at great eminence, such as Cipriano Rose, Zarlin, and Cofitano Porta. In the title of a book, published at Venice, 1549, there are "Fantasia," or "Ricercari," composed dallo excellenzissimo Adrian Vuilgart, and Cipriano Rose, suo discepolo. P. Martin, in his Saggio di Contrappunto, p. ii. p. 266. calls Adrian Willaert the master of Cofitano Porta: Burney, WILAFANS, in Geography, a town of France, in the department of the Doubs; 3 miles S.E. of Orans. WILAKALA, a town of Sweden, in Finland; 48 miles E. of Biernorge.

WILLAWARY, an Indian town on the N.W. coast of lake Michigan. N. lat. 47° 45', W. long. 87° 10'.

WILLDENOVIA, in Botany, received its name from professor Thunberg, in honour of Dr. Charles Lewis Willdenow, late professor of botany at Berlin, well known as the author of many learned botanical writings, but especially by his Species Plantarum, of which the immortal work of Linn€us, bearing the same title, is the basis. The addition of essential characters, and of many new species, besides those accumulated in profusion, with great intelligence and discrimination, from authors subsequent to Linneus, might entitle this to rank as an original work; were not the Linnean part of it too servile a transcript, not only of mistakes, of remarks contradicting each other, and of evidently false synonyms; but in general of errors of the press, and wrong citations of plates and pages, which prove that the respective books, though in every body's hands, were not consulted. The learned editor happily lived to complete the first part of the fifth volume, comprising the order of Ficus, in which he was well verified. That he left the rest of the Cryptogamia unattempted, is perhaps rather fortunate than otherwise. The Mucl, Lichen, and Fungi, each form a study by themselves, and are treated of separately by different authors. They would have added enormously to Willdenow's work, and could, after all, have proved but a compilation. If the science goes on as it has done, an universal botanist will be nearly as impossible a character as an universal naturalist is at present.

Another genus (see Schlechtendaia) was dedicated to Willdenow by Cavanilles, which is retained in Lamarck's Illustrations, t. 685, by the name of Willdenovia. The change of orthography at the conclusion we readily adopt, instead of the uncouth Willdenovia, or Willdenovia, and it is now likewise followed by Thunberg himself, in his Flora Capensis.—Thunb. in Stockh. Trans. for 1790, 26. Prodr. 14. Fl. Capens. v. 1. 312. Willd. Sp. Pl. v. 4. 717. Poiret in Lamarck Dict. v. 6. 177.—Clfs and order, Dioe- cia Triandra. (Triandra Monogyna; Thunb.—Nat. Ord. Tripetaloides, Linn. Junci, Julit, Rejilenses, Brown Prodr. v. 1. 243.

Gen. Ch. Male, Cal. Perianth inferior, of numerous, imbricated, membranous, pointed, permanent glumes, longer then
than the fruit. Cor. Petals fix, equal, erect, oval, membranous, permanent. Stam. Filaments three, capillary, shorter than the corolla; anthers ovate-oblong.

Female, Calyx and corolla as in the male. Tip. German superior, roundish; style very short, two or three-crested, stigmas two or three, downy. Peric. Drupa dry, roundish, smooth. Seed. Nut solitary, of one cell.


Female, Calyx and corolla as in the male. Style one. Stigmas two or three. Drupa with one seed.

Obi. This genus differs from Restio (see that article), chiefly in having a single-leaved drupa instead of a capitulum, opening by valves, and containing several seeds. We have here merely altered the phraseology respecting the calyx, which in Restio is termed, rather improperly, a catkin.

1. W. fritata. Striated Willdenovia. Thunb. in Stockh. Trans. for 1790, 27. t. 2. f. 1. Fl. Cap. v. 1. 312. Wildl. n. 1. Poiret n. 3. —Stem leafless, round, flattened. —Native of the Cape of Good Hope, as are likewise the two following species. The stem is two feet high, or more, erect, rusty, hard and rather shrubby, branched, usually simply forked, rarely three-forked, round, jointed, flat, smooth; the branches also round, flattened. Sheaths at each joint and subdivision solitary, ovate, close, brown, smooth. Leaves none. Flowers terminal, solitary, erect, the fize of a pea. Scales of the calyx about ten, rarely fewer, or more, loosely imbricated, equal, oblong, pointed, brown, smooth, the length of the nail, membranous at the edges. Petals ovate, acute, as long as the fruit. Style undivided. Stigmas three, feathery. Drupa ovate, compressed, obtuse, grey. Thunberg.

WILLERBROD, in Biography, the apothecary of Frieland, was an Anglo-Saxon, and born in Northumberland about the year 658, and educated in the abbey of Rippon, where he engaged in the religious profession. At the age of 33, he accompanied eleven of his countrymen into Batavia, and employed himself for three or four years in converting the Frisians who were under the French domination; and having met with great success, he went to Rome, and received from pope Sergius the pallium, ordaining him archbishop of Frieland. Pepin gave him a residence at Wilteburg, now Utrecht, of which he was the first prelate. Embarking from Frieland for the north, he penetrated into Denmark, and in his return was cast by a storm on an island called Fofeland, supposed to be the same with Heligoland. He afterwards baptized Pepin, son of Charles Martel, and spent the rest of his life in propagating Christianity among the Batavians. His colleague and assistant was Visfrid, his countryman, surmounted Boniface, the apostle of Germany. He died in 740, at the age of 82; was buried at his abbey of Eflernac, in the diocese of Treves, and honoured with canonization. His life was written by the celebrated Alcuin. Mosheim. Moreri.

WILLENSTADT, or WILLIAMSSTADT, in Geography, a strong town of Holland, situated upon that part of the Meuse called Buttermel, built in 1584, by William I., prince of Orange, from whom it receives its name. This fortress is one of the keys of Holland, and defended with seven bastions and double fosse; it has also a good harbour, but which is sometimes dangerous for vessels to enter at certain times of the year. It was besieged by the French in the year 1753, but by the brave resistance of the governor and garrison, aided by the English, with gun-boats, &c. the besiegers were compelled to retire with great loss; 12 miles S.W. of Dort. N. lat. 51° 41'. E. long. 4° 18'.

WILLERNBERG, or WILDBERG, a town of Prussia, in the province of Oberland; 93 miles S. of Königberg. N. lat. 53° 11'. E. long. 20° 53'.

WILLERING, a town of Austria, on the Donabe; 4 miles W. of Lintz.

WILLERSDORF, a town of Bavaria, in the bishopric of Bamberg; 5 miles S.W. of Forchem. WILLET'S Bay, a bay on the north-west coast of the island of St. Christopher, about a mile to the south-west of Dieppe Bay.

WILLIAM I., called "the Conqueror," king of England, and duke of Normandy, in Biography, was the natural son of Robert, duke of Normandy, by Arlotta, the daughter of a tanner, and born in 1024. When his father went on a pilgrimage to Jerusalem, and his son was only nine years of age, he caust the fates of the duchy to swear allegiance to William, as his heir. On his return in 1033, Robert died; and the conquefs was a variety of diftinctions among the barons of the duchy, in which Henry I. of France took a part; so that when William arrived at majority, he found his dominions in a low and disaffected state. But his vigour and exertions soon restored order and submission, and general tranquility through his duchy. Edward the Confessor, at this time king of England, had no children; and the archbishop of Canterbury, who was a Norman, recommended his adopting William as his successor, and he was commissioned by the king to inform the duke of his intention. However, as he had not publicly divulged his purpose, Harold, the son of earl Godwin, ascended the throne without opposition, on his decease.
in 1066. Harold, however, had previously taken a solemn oath to assist William in accomplishing the purpose of Edward respecting the succession; and his perjury excited the indignation of William, and induced him to prepare for disappointing Harold of the English throne by force of arms. His intentions were not sooner announced than he was joined by a great number of military adventurers; and upon an appeal to Rome, the pope sanctioned the contest, and sent him a consecrated banner. Thus encouraged, he assembled a fleet of 3000 vessels, and an army of 60,000 men; and determining on invading England, landed on September 28, 1066, at Pevensey, in Sussex. Harold, as soon as he received this intelligence, marched from York, and having recruited his forces at London, hastened to encounter the Normans, who were encamped near Hastings. On the 14th of October the two armies engaged, and after a severe battle, which lasted during a whole day, the English were defeated, with the loss of Harold and his two brothers. William lost no time in availing himself of this victory; but having reduced the town and castle of Dover, and received the submission of the Kentish men, proceeded towards London. In his way he was met by Edgar Atheling, who had been proclaimed legal heir to the monarchy, Stigand, archbishop of Canterbury, and some of the principal nobility, who made an offer to him of the crown; and on Christmassday, 1066, after a kind of tumultuous election, he was crowned at Westminster-abbey by the archbishop of York, and took the coronation-oath. Having adopted measures for conciliating his subjects, and overawing those who were adverse to him, he re-crossed the sea to Normandy, taking with him hostages Edgar, the primate, and several of the principal nobility. Soon after his departure, the English were treated contumeliously and oppressively by the Normans, whose conduct excited insurrections, and led to a conspiracy for the massacre of all who remained in the country. This intelligence occasioned William's return in December 1067; and among other measures of a more conciliatory nature, he improvidently renewed the tax called "dangelt," which excited insurrections through various parts of the kingdom. As soon as these insurrections were suppressed, his queen, Matilda, was crowned at Westminster; but new troubles arose from the union of the two principal nobles, Edwin and Morcar, with the kings of Scotland and Denmark, and the prince of North Wales, which threatened an extensive revolt. The conspiracy for this purpose was discovered and crushed, and measures were taken for preventing the evils that were likely to result from it. From this time William's government became daily more and more despotic; and the nobility of the country, perceiving that their ruin was the object of his contemplation, prepared to leave the kingdom. Insurrections broke out in various parts of the country, and the means which he adopted for suppressing them were in the highest degree rigorous and destructive. As a measure of future prevention, he brought from Normandy the feudal constitution into England, and divided most of the lands into baronies, which he granted to the most considerable of his followers, under the condition of certain services and payments; and these subdivided their shares on similar tenures, among others, chiefly foreigners, of inferior rank. The ecclesiastical property of the kingdom was regulated upon a similar footing; and under various pretences, the Normans superfed the English in the possession of all church dignities. In order to favour this expulsion of the English dignitaries, a legate from the pope was, for the first time, admitted into this country, and a reverence for the fee of Rome, similar to that which subsisted on the continent, was inculcated on all British sub-
jects; whilst the king took care, by referring certain powers to himself, to guard the civil sovereignty against papal usurpations. In order further to subjugate the minds of the English, and reduce them to the state of a conquered people, the king projected the abolition of their language; and by admitting at court no other language besides the French, he caused all the youth in the schools of the kingdom to be instructed in it, and the laws to be drawn up in that language, which was also used in all judicial pleadings and writings.

Having suppressed an insurrection which broke out in 1071 by the instigation of the earls Edwin and Morcar, and in the following year negotiated a peace with Malcolm, king of Scotland, he was called to Normandy in 1073, on occasion of a revolt in that country. In 1075 his presence was necessary in England to check a conspiracy among the Norman barons, whom he had distinguished by his favour, and who were joined by Waltheof, an English nobleman, on whom he had bestowed his niece Judith. Waltheof, in this conspiracy, fell a sacrifice to the treachery of his wife. In the following year, viz. 1076, the haughty and ambitious Hildebrand, who was now pope Gregory VII., required William to do homage for his kingdom to the holy see, alleging a promise to this purpose, and also to pay the accustomed English tribute. William denied his promise of homage, which he refused to render, but remitted to Rome the Peter-pence, and whilst he would not allow the English prelates to attend a general council summoned by Gregory, he permitted the pope's legate to convene a synod at Winchester for establishing the celibacy of the clergy. On his return to Normandy in this year, he found the country engaged in a civil war, in consequence of a rebellion excited by his son Robert. On this occasion the father and son had a personal encounter; but when the son discovered that he was thus engaged, he was struck with horror, fell at his father's feet, and implored forgiveness. The father was at first unrelenting; but they were afterwards reconciled. About the year 1081, William ordered that survey of the landed property of the kingdom to be made which is recorded in Domesday-book. (See DomEesy.) For an account of the impolitic as well as cruel manner in which he indulged his passion for the chase, we refer to the article Forest.) The latter years of his life furnished various occasions of affliction and disquietude. The death of his queen Matilda, to whom he was affectionately attached, was an event that took place in 1083, and was the cause of undiluted sorrow and lamentation. The preparations made by the king of Denmark and the earl of Flanders for an invasion of England occasioned to him no small degree of anxiety; and when he was rescued from this danger by the death of the Danish king, he was called into Normandy in 1086, to repel the incursions of some French barons; and suspecting that the king of France had instigated them to these acts of hostility, he commenced a war against him in 1087, in the prosecution of which he even laid waste the country at the approach of harvest by the most cruel devastation. But an accidental injury which he received in mounting his horse stopped his career, and terminated in his death. Alarmed by the near prospect of dissolution, his mind was harassed with remorse in the review of the atrocious conduct with which he was chargeable, and he sought relief by donations to the church, to which person of his characters have commonly referred, and by the pardon and release of some of his enemies. By his last testament he bequeathed to his eldest son Robert the counties of Normandy and Maine, and to his second son William, the crown of England, and to his third son, Henry, the property of his mother. He expired at the abbey of St. Gervais, near Rouen,
On but and very general. But his passions were strong, his disposition was severe and merciless, and his ambition and love of rule caused him to disregard all restraints of justice and humanity. There never was a more fortunate usurper of a throne, which he transmitted to a long and still fulfilling line of descendants; and the establishment of his dynasty is the most conspicuous era of English history." — Ralph Hume. Henry Lyttleton. Gen. Biog.

**WILLIAM II.** Furname Rufus, second son of the Conqueror, and king of England by his father’s nomination, was crowned at Westminister in September 1087, and recognized as king when he was about 27 years of age. His brother Robert succeeded to the dukedom of Normandy by the deposition of his father, which proved the occasion of much discontent and contention; partly because the great barons possessed estates both in England and Normandy, and under separate governments; and partly because Robert was the eldest son, and the most popular. A conspiracy was formed by the maternal brothers of the late king, in which many nobles concurred for deposing William. But William,possessing a certain portion of his father’s vigour, took measures for defeating them. With this view he conciliated the native English, took possession of the castles and persons of the unfortunate barons, banished them to Normandy, and bestowed their estates on his faithful adherents. When he was firmly seated on the throne, he forgot his promises of relieving the English from oppression, and even enhanced the severity of the forest laws. The death of Lanfranc, whom he respected, left him at liberty to seize vacant bishoprics and abbeys, and to bestow church lands on his captains and favourites. In 1099 he visited Normandy with hostile intentions respecting his brother; but a negotiation took place, and they were reconciled. Robert accompanied William to England, and commanded an army which was sent against Malcolm, king of Scotland. But a variance soon took place between the brothers, occasioned by the encroaching and treacherous disposition of William, which led him to excite the Norman barons to rebel against Robert. Whilst William was prosecuting hostile measures against his brother, he was recalled to England in 1095, to suppress a conspiracy among the barons in the north, whom he speedily defeated and severely punished. The spirit of crusading having at this time pervaded Europe, Robert was seized with the mania, and mortgaged his dukedom to William for 10,000 marks, in order to enable him to unite with the crusaders in 1096. William, having gone over to the continent to take possession of Normandy and Maine, was taken extremely ill, and apprehending danger, resolved to repair the injury which he had done to the church, and to supply the vacancy of the archbishopric of Canterbury, which had continued from the death of Lanfranc. The ecclesiastic nominated on this occasion was Anfelm, who, notwithstanding the disinclination he had manifested against accepting the appointment, was afterwards a zealous defender of the rights of the church, and of ecclesiastical authority in general. The king and the primate then disagreed; and though a synod was assembled for the deposition of the archbishop, the king failed in the attempt. But when Anfelm defined permission to leave the kingdom, he obtained leave; but his temporalities were seized, and the pope received him as a confessior in the cause of religion. William’s French acquisitions were the occasion of trouble to him; for whilst he was hunting in the New Forest, he received information that the citadel of Maine was besieged, and he therefore hastened to Dartmouth, and determined to embark without delay. As the weather was tempestuous, the mariners expressed some apprehension of danger; the king, however, was resolute and persevering, and asked them if they had ever heard of a king who was drowned. Having accomplished his object, he was applied to by the duke of Guienne, who was under the influence of the passion for crusading, for the loan of a sum of money, as a mortgage on his rich provinces of Guienne and Poitou. William accepted the proposal; but whilst he was preparing to carry over the money, and to take possession of the provinces, he was accidentally killed in the New Forest. Having alighted from his horse after a chase, a flag sprang up near him; and a French gentleman, Walter Tyrell, perceiving the animal, shot off an arrow, which glanced from a tree, entered the king’s breast, and penetrated to the heart. Tyrell immediately fled, and embarking for France, joined the crusaders. The king’s body was found by the country people, and interred without ceremony at Winchester. This happened on August 2, 1100, when the king was in the 40th year of his age, and the 13th of his reign. The character of William Rufus has been unfavourably represented, both on account of the depredations which he committed in the church, and of his indifference to religion. "The incidents of his reign," says a biographer, "prove him to have possessed vigour and decision, courage and policy; but to have been violent, pernicious, and rapacious, and void of all sense of justice and honour. One of his best public acts was the sending Edgar Atheling into Scotland, to restore prince Edgar, son of Malcolm, to the throne of that kingdom, of which he was the lawful heir. He deserves to be regarded as a promoter of the useful arts by his still-remaining erections of the Tower, London-bridge, and Westminster-hall." — Gen. Biog.

**WILLIAM III.** King of England, prince of Orange, and stadtholder of Holland, was the posthumous son of William II., prince of Orange, and of Mary, daughter of Charles I., king of England, and born on November 14, 1650, at a very interesting period. His guardianship was divided between the prince’s-royal his mother, the princes-dowager his grandmother, and the elector of Brandenburg. During the negotiations that succeeded the naval war between the English and Dutch republics, Cromwell, the protector, stipulated, that the prince of Orange, who was a branch of the house of Stuart, should be for ever excluded from the stadtholderate; but on the event of the Restoration, the prince’s-royal petitioned, in 1662, that her son might be invested with the offices and dignities which belonged to his ancestors; and soon after the act of exclusion against him was annulled. Although the states of Holland would not admit, as a condition of peace in the succeeding war between England and the United States, the preliminary proposed by Charles II. of elevating the prince to the stadtholderate, they formally adopted him as "a child of the state," and placed him under the care of persons who should inspire him with principles suited to his situation under a free government. After some subsequent debates concerning the rank which should be assigned him, he was raised in 1670 to the dignity of first noble of Zeeland, and then admitted into the council of state. On occasion of the war, which was declared by Lewis, and his pensioner Charles, against the United States in 1672, the public voice obliged the magistracy of Holland to revoke the perpetual edict procured by De Witt for abolishing the stadtholderate,
ate, and to confer that dignity with all its prerogatives upon William. Thus authorized by the States to change the regency in all the most considerable towns of Holland and Zealand, party opposition was extinguished, and every proposal for the defence of the country was unanimously adopted. The prince, at this early age, fully justified the confidence that was reposed in him by the firmness and elevation of his mind. At an extraordinary assembly of the states, he pointed out, in an elaborate speech, the pernicious consequences that must result from the “peace proposed by the French king, who was in possession of three of the provinces; he shewed the possibility of raising supplies for a war in defence of their religion and liberty; and by the cool intrepidity of his manner and force of his arguments, he produced such an effect upon his before-defending audience, that they concurred in the resolution of making every sacrifice, rather than defer the cause of their country. Vigorous measures were entered upon; foreign alliances were formed; fortunate circumstances prevented the further advance of the French, who evacuated the province of Utrecht; Charles II. was obliged by his parliament to make peace, in 1674, with the Dutch, who in the same year signed separate treaties with the bishop of Munster and the elector of Cologne; and at length the three conquered provinces were re-united to the States General, and the conduct of the prince of Orange so much ingratiated him with the states of Holland, that the offices of stadtholder and captain-general were declared hereditary in his male line.” In all his military actions, he displayed both courage and wisdom; so that the prince of Condé testified in his favour, that at the battle of Steen, “he had in every point acted like an old captain, except in venturing his life too like a young follower.” The humiliation of the French king seems to have been his favourite object; and with this view he wished to fix the English court in the same interest. This was one motive which induced him to connect himself more closely with the royal family, by a marriage with Mary, eldest daughter of the duke of York. Accordingly he came into England in 1678, and then the nuptials took place which were so satisfactory to the nation, and which were afterwards followed by the most important consequences. Without enlarging on the measures pursued by the prince on the continent, we shall direct our attention to those in which our own country was more immediately interested. The succession of the prince’s father-in-law to the crown of England in 1685, instead of strengthening the bonds of affinity by which they were attached to one another, served only to separate them more widely. The king was a bigotted papist, and the prince was regarded as a great supporter of the Protestant cause on the continent, and therefore they could not cordially concur in their views and operations. King James, whose object was to render the Catholic religion predominant, began with endeavouring to procure for it a free toleration in Great Britain, by a repeal of the penal laws and the test-act; and in order the more effectually to accomplish his purpose, he strongly solicited the prince of Orange to express his concurrence and that of the princely, but as they knew how unpopular the design was in England, they refused to grant it. About this time Lewis XIV., under the influence of his own bigotry, and that of those with whom he acted, repealed the edict of Nantes, which had secured the privileges of his Protestant subjects; and by his harsh treatment of them, drove numbers of them out of his dominions, and thus excited a dread and hatred of popery through all Protestant countries of Europe. The effect of this measure with regard to the prince of Orange was, that it supported all party opposition to him in Holland, and gave him additional importance in Europe, as the determined foe of French ambition. The arbitrary proceedings of king James alarmed all the friends of civil liberty, and of the established religion in England; and apprehensive of danger, they directed their views to the prince of Orange as their deliverer. Accordingly conferences were held with a confidential envoy whom he sent over to ascertain the public opinion; applications were made to the prince by several persons of rank; and at length, when the birth of a prince of Wales disappointed all hopes of a Protestant succession, the leading men of different parties concurred in actually inviting him to come over, and to undertake the protection of the church and constitution from threatening ruin. The prince consented, and with consummate prudence and secrecy prepared for the interesting expedition; and as exiling circumstances afforded a prospect of a breach between the United States and their allies, and the king of France, he was thus enabled to augment the Dutch forces by sea and land without suspicion. Having previously dispersed through the kingdom a declaration, stating the grievances of the reign, and announcing his intention of bringing over an armed force to defend the nation from tyranny, and to procure the assembling of a free parliament, he put to sea in October 1688, with a fleet of about 500 vessels, and an army of 14,000 men. He was once driven back by a storm, but a second attempt succeeded, so that he gained the English coast without opposition, (the king’s fleet being wind-bound,) and on the 5th of November disembarked his troops at Torbay. Of the causes, progres, and termination of the Revolution, we have given an account under the articles JAMES II. of England, and REVOLUTION. King William feated on the throne became sovereign of a powerful kingdom; but his tranquill possession of the crown depended on a variety of circumstances which he could neither directly nor controul. The conflict of different parties was not easily restrained; nor were his disposition and manners, which were cold and reserved, notwithstanding all his excellent qualities, adapted to unite and conciliate the partisans of the old and new government. Amongst those who had taken an active part in the late measures, or who had acquiesced during their progress, some were dissatisfied with the total exclusion of James and his infant son; and others could not approve the transfer of the crown by the will of the people. In Scotland, the appointment of William was the act merely of the whigs; and in Ireland, where the population was chiefly Catholic, the interest of James was predominant. The church zealots in England were not pleased with the tolerant principles manifested by king William, and with the wishes he expressed for the comprehension of the dissenters. Thus circumstances, the commencement of his reign was embroiled by the open opposition and secret intrigues of his enemies, and in the progress of it the collision of parties was the occasion of much personal disquietude both to him and to the queen. His attention was for a considerable time distracted by the state of his native country, when war with France was renewed in 1689, by James’s invasion of Ireland in the spring of that year, when his interest with the Catholics was powerful, and in which he was aided by the French king, and also by an insurrection of the Jacobite party in Scotland. Ireland feemed at this time to demand his principal exertions; for though marshal Schomberg had been sent over in 1689 to oppose the progress of the late king, little had been done to any important purpose. Accordingly in the summer of 1690, he embarked with a reinforcement for this country, and by the battle of the Boyne, in which Schomberg was killed, he
he routed the Irish army, and totally dispersed it. James abandoned the contest, and fled precipitately to France, leaving the reduction of the island to William, which was completely effected in the following year. Whilst he was thus engaged in military operations, a party spirit agitated his domestic government. The convention parliament, consisting of wigs, who were his decided friends, dreaded monarchical power, and refused to settle upon him the crown reversion for life. Hence he was led to dissolve the parliament in disgust; but he soon found that the new parliament, in which the influence of the Tories preponderated, though it readily indulged his desires with regard to the revenue, and voted liberal supplies for the Irish war, was composed of persons that were not real friends to the principles which placed him upon the throne. We shall leave to the details of history the events that occurred on the continent in the prosecution of the war against France; and proceed to observe, that in the year 1663 he suffered a severe loss by the death of queen Mary, who had proved herself an affectionate wife, and both faithful and zealous in promoting his interest; nor was his attachment to her less ardent and sincere. The decease of Mary revived the hopes of the Jacobites, and they were busy and active in forming conspiracies, not scrupling to concert the atrocious plan of assassinating the king. In 1667 peace with France was concluded at Rytwick, and Lewis was reduced to the necessity of acknowledging William as the lawful sovereign of Great Britain, and to make no future attempts for dispossessing him of his throne. The next contest, that engaged political parties at home related to the reduction of the military establishment. King William, attached to a military life, and not very confident with respect to his own security on the throne, wished to retain a greater force than parliament was disposed to allow; which was no more than 7000 men, who were to be all natives; so that he was under a necessity, though with great reluctance, of parting with his favourite Dutch guards. The next political object that engaged the king's attention was connected with the balance of power in Europe, and that was the succession to the crown of Spain, upon the death of Charles II., who was in a declining state of health, and who had no issue. In 1701 the king of Spain died, and left a testament in favour of the grandson of Lewis XIV., which will was accepted by the French king; and of course preparations were made by William and the Dutch for renewing the war with France. This measure was further rendered necessary by the death of James II., in the same year, and Lewis's acknowledgment of his son as king of Great Britain. On the meeting of the parliament at the end of this year, William made a speech on the state of affairs, on his own proposed conduct, and on the necessity of mutual confidence between the crown and people. This speech was much applauded, and was answered by a very loyal address. Thus was his reign, which had been distinguished by its vicissitudes and trials, and by the extensive and permanent benefits that resulted from it, drawing to its termination. A fall from his horse gave a shock to his enfeebled constitution, and brought on a fever, the issue of which he tranquilly expected; and he expired on the 8th of March, O.S. 1702, in the 52d year of his age, and 13th of his reign.

The character of king William has been variously delineated by political writers of different sentiments and dispositions. All allow that he possessed considerable political talents, and though in his military operations he was often unsuccessful, few persons exceeded him in his ability for repairing losses, and making a good close of a campaign. Although, as we have before said, his manners were cold and reserved, he was not destitute of sensibility. The partisans of James, and those who disapproved of the Revolution, have cenured his conduct in deposing his father-in-law; but public liberty and the welfare of a nation must be ever regarded as paramount to private duties. He never fought power otherwise than for accomplishing the important and beneficial ends to which his views were directed; and therefore he cannot be justly charged with a culpable degree of ambition. Whatever may be the opinion of erroneous and interested individuals of the Jacobites and Tories of more ancient or modern times, "he will ever be gratefully remembered," as one of his biographers says, "by the United Netherlands; as the great founder of their freedom and independence; and will be honoured as the deliverer of the British isles from tyranny, civil and religious, as long as a due sense of the benefits of that deliverance subsists among their inhabitants."

There are few more conspicuous instances of the power of the cultivated mind in the promotion of public affairs than William of Nassau, prince of Orange, and founder of the Dutch republic, who was born in Germany in 1533, and descended from Lutheran parents, though, being introduced into the service of Mary queen of Hungary, and afterwards of Charles V., he conformed to the Catholic religion. He was trained to military and civil employments of high rank; and as he had ample possessions in the Low Countries, he attained to the dignity of governor of the provinces of Holland, Zeeland, and Utrecht, under the Spanish government. His character is very highly drawn, and is said to have combined magnanimity, prudence, bravery, equanimity in all fortunes, singular penetration and sagacity, retentive memory, popular eloquence, and the art of conciliating men's affections. Upon the introduction of the inquisition by the bigotry of Philip II., a flame broke out in the Netherlands; and the prince of Orange, with the counts Egmont and Hoorn, did everything in their power to restrain the severity exercised on a religious account, and to induce the Spanish court to recall cardinal Granvelle, to whose influence solely they were owing; and in this effort they succeeded in 1564. On occasion of the faininary measures proposed in the councils of Philip, and carried into execution by the duke of Alva, the prince of Orange, the moderation of whose temper caused him to be suspected, surrendered his employments, and retired with his family, in 1567, to his brother at Nassau. Alva, having arrested counts Egmont and Hoorn, and occasioned them to be condemned and executed, cited the prince of Orange to answer charges of sedition and treason that were preferred against him; and on his non-appearance, his estates were confiscated, and his eldest son, a studen at Louvain, was carried off into Spain. William, who about this time seems to have declared himself a Protestant, levied an army with a view of penetrating into Brabant; but Alva's military skill defeated his purpose, and he was under a necessity of disbanding his troops. Still determined on relieving his country, he made another application in 1571 to several Protestant powers for succour, but they were all averse from encountering the power of Spain. At length he obtained from the court of France some supplies of money, and was then enabled to fit out a small squadron, which,
in 1572, took possession of the port of Brill. This trivial
successes routed the spirits of the Netherlanders, and several
places in Zealand and Holland declared for the Orange
party. At length a convention of nobles and deputies from
the principal towns in Holland took place at Dordrecht,
and forming themselves into an independent state, chose
William for their chief. Convinced by the massacre of
the Protestants in France, that it was in vain to expect
affiliation from that quarter, he dismissed his troops, and retired to
Holland; and whilst Alva was exercising his usual severity,
the people of Holland and Zealand alone remained in
arms against the Spanish government; and the preference of
William gave order and stability to the new republic. Altho-
ough the duke of Alva was recalled from his government
in 1573, the cause of independence was in a very precarious
state. However, in 1574, the states of Holland and Zea-
land conferred on William the sovereign authority over
the war, and formed a treaty of union and alliance with each
other. Peace with the court of Spain could not be obtained
otherwise than on terms which could not be accepted; and
the aspect of affairs in 1576 was very discouraging. At
length, however, the death of Requesens, who had succeeded
Alva as governor, and the deprivations to which the towns of
Brabant and Flanders were exposed, favoured William
in his efforts to accomplish a general union of the provinces of
the Low Countries for mutual defence; and this was
effected by the treaty, called the pacification of Ghent.
William was now justly regarded as the true patron of
public liberty. At the beginning of the year 1579, the
duke of Parma being the Spanish governor, the union of
Utrecht was signified, which was the basis of the confedera-
tion of the Seven United Provinces, all of which, by their
deputies, concur in forming it. When the separation of
the Catholic and Protestant Netherlands took place, the
latter, being distressed, sought the affiance of France, by
nominating, in 1580, the duke of Anjou, brother to
Charles IX. king of France, for their sovereign, and
re-nouncing their allegiance to Philip; but the administration
of Holland and Zealand was still entrusted with the prince
of Orange. Philip, desiring this measure to William, promised
an edict of proscription against him; in consequence of
which his life was in danger, and an attempt was made to
assassinate him. At length he fell a victim to the fanaticism
of a native of Franche-Comte, who was urged forward by a
Cordelier and a Jesuit, who, under pretense of business,
obtained access to him, and shot him through the body.
He fell, and ejaculating "My God! have mercy upon me
and thy poor people," instantly expired, on July 10, 1584,
having nearly completed his 52d year. He was interred
with great honour and solemnities of respect, at Delft. He
was four times married, and had issue by each wife. His
second son, Maurice, succeeded to his authority in the
United Provinces. (See Maurice.) William, having
been educated in a court, acquired the manners and habits
of a statesman, and was charged with diffimulation and proud
ambition. But his objects were always pure and patriotic,
and he zealously preserved the liberties of his country; and,
though he has been traduced by the advocates of despotism,
his remains have the highest tokens of respect from a people
who gratefully acknowledge him as the principal author
of their freedom and independence. 

William of Wykeham, an English prelate, was born in
1324, at Wykeham in Hampshire, and by the liberality
of a patron, educated at Winchester school, and afterwards
recommended to Edynsgord, bishop of Winchester, who intro-
duced him into the service of king Edward III. about his
23d year. Acquiring extraordinary skill in architecture, he
was appointed in 1356 clerk of the king's works in two
mansions, and surveyor of the royal works at the castle and
in the park of Windsor. The king was so highly satisfied
with his conduct in these similar departments, that he recom-
pended him by several preferments, civil and ecclesiastical.
In 1359 he was nominated chief warden and surveyor of the
royal castles of Windsor, Leeds, Dover, and Hadiam, and
of several other castles, mansions, and parks. Whilst he had
only the clerical tenure, he enjoyed many ecclesiastical
dignities; and, in order to his further advancement in the
church, he was ordained priest in 1362. In the following
year he was made warden and jurenoary of the royal forests
south of Trent, and in 1364 keeper of the privy-veal. He
was also chief of the privy-council, and governor of the
great council; and besides other civil preferments which he
enjoyed, he succeeded Edynsgord, in 1366, as bishop of Win-
chester, which paved the way for his elevation to the post of
high-chancellor in 1367, of which latter dignity, however,
he was divested in 1370. Thus possiably ample means of
municibns in a state of celibacy, and a liberal spirit, his pro-
fession as an architect led him to repair and erect numerous
buildings in his fee at an expense of no less than 20,000
marks. He also directed his attention to the improvement
and proper discipline of the religious houses comprehended
within his diocese. For the better education of his clergy,
he laid the foundation of a college in Oxford, which was to
be supplied with students from a feminary at Winchester. He
was interrupted, however, in his liberal designs of general
utility by an impeachment for misconduct in the administra-
tion of public affairs, occasioned by the influence of the duke
of Lancaster, who had conceived a prejudice against him;
and, in consequence of this impeachment, his temporalities
were feized to the king's use, and he was banished from court.
The clergy, however, interfered, and the people regarded
him as a sufferer from the duke's exorbitant power; so that
a tumult ensued, that procured the restoration of his tem-
poralities, and his recovery of the royal favour, a little while
before the king's death. During the turbulent reign of
Richard II. Wykeham conducted himself with caution, and
succeeded in the establishment of his two colleges. For that
alone he obtained a patent in 1370, and it was completed
in 1386. It is now known by the name of the New
college. His college or school at Winchester was finished
in 1393. He also undertook the repair of the cathedral,
which was a Saxon edifice of the eleventh century, and in
the course of ten years rebuilt in the Gothic style. (See Win-
chester.) In 1384 he was induced, against his inclina-
tion, to accept the office of high-chancellor, which he
resigned again in 1391, after having restored the public
tranquility. When the king recovered his authority, he
procured a parliament in 1397, which impeached several of
the commissioners, who had almost divested him of his au-
thority, of high treason; but Wykeham, who was one of
them, escaped with a forced loan of 1000l. He attended
the first parliament of Henry IV. in 1399, which depo-
sed Richard, but was not present at the council, which adjudged
him to perpetual imprisonment. As his health declined, he
was disabled from performing the duties of his office; and
therefore nominated coadjutor in his bishopric, settled all his
temporal and spiritual concerns, and with tranquility spent
his dismission from the world. This happened in September
1404, when he had finished his 80th year. His remains
were interred in his own chapel or oratory in Winchester
cathedral, where a tomb of white marble was erected to
his memory. Lowth's Life of William of Wykeham.

Biog. Brit.

3 M
WILLIAMS, Daniel, D.D. in Biography, an eminent non-conformist divine, was born at Wrexham, in Denbighshire, about the year 1643 or 1644. The disadvantages of his early education were counterbalanced by the natural vigour of his mind, and by future application. Devoting himself to the ministry among Protestant dissenters, he was one of the first who had resolution to engage in it, after the privations and sufferings which followed the Act of Uniformity in 1662. At the age of 19 years he was admitted a preacher among the Presbyterians, and for several years officiated occasionally in several parts of England. Being here in danger of persecution, he accepted an invitation to become chaplain to the countesses of Meath in Ireland, where dissenters enjoyed a greater degree of liberty; and some time afterwards he became pastor to a respectable congregation in Wood-lreet, Dublin. Here he continued for nearly twenty years, exercising his ministry with acceptance and usefulness, and conducting himself so as to maintain harmony with his brethren in the ministry, and to secure respect and esteem from the Irish Protestants in general. During his residence in Dublin, he married a lady of an honourable family, with a considerable estate. Towards the close of the reign of James II., his opposition to popery rendered his situation in Ireland unpleasant to him, and he therefore came over to England in 1687, and settled in London. Here he joined those ministers who opposed an address to the king on occasion of his dispelling with the penal laws; and by his firmness and intrepidity contributed in no small degree to their unanimous rejection of it. Out of his own funds, and by his wealthy connections, he procured relief for those Irish Protestants who sought refuge in London from the tyranny and persecution of Tyrconnel. After the Revolution in 1688, which was an event that gave him and his brethren inexpressible satisfaction, he was often consulted by king William on Irish affairs; and his reports concerning the abilities and character of Irish refugees, who were capable of serving the government, were duly regarded.

On occasion of his visit to Ireland, in the year 1700, for settling his own affairs, his conduct in the influences now specified was gratefully acknowledged. Towards the latter end of the year 1688, he was unanimously chosen pastor to a numerous congregation of Presbyterians in Hand-alley, Bishopsgate-street; and in this connection he spent the remainder of his days, devoting to charitable purposes the salary which he received from his congregation. With the famous Richard Baxter he cultivated an intimate acquaintance; and at his death, in 1691, he was chosen to succeed him at the Merchants' Tuesday lecture in Pinners' hall. Some of his fellow-leachers advanced what he conceived to be Antinomian tenets; and these dangerous notions he thought it to be his duty to oppose. Hence arose a suspicion of his orthodoxy, and an attempt to exclude him from the lecture. Their design was frustrated by a majority of the subscribers; but as their opposition was inveterate, it was thought most advisable to separate and to establish another Tuesday lecture at Salters' hall. Three of the most respectable of the old lecturers, viz. Dr. Bates, Mr. Howe, and Mr. Allop, succeeded with Williams.

Upon the publication of the works of Mr. Crisp, who avowed himself the champion of Antinomianism, Mr. Williams undertook to refute them; and in 1692 published his "Gospel Truth stated and vindicated, &c." 8vo.; a work which, though now almost forgotten, was deservedly approved by the principal London ministers of that period; and as it is distinguished by great clearness and strength of argument, as well as a truly Christian temper, it served to check the pernicious errors which were then indifferently circulated. It was defended by the author in his "Defence of Gospel Truth, &c." 8vo., and in a "Prefcript" to a new edition of his work, and also in other pieces. Against the charge of Socinianism, an appeal was made to Dr. Stillingleet, then bishop of Worcester, and Dr. Jonathan Edwards of Oxford, who were deemed masters and judges in this controversy; and they, honourably acquitted the author, with many expressions of respect for him. Disappointed in their efforts to induce a suspicion of his orthodoxy, his enemies indulged their malignity further by arraigning the purity of his morals. Indignant as he well might be at this attack, he submitted his conduct to the investigation of the United London Ministers, who concurred in the report of their committee, "that he was entirely clear and innocent of all that was laid to his charge." The attachment of his congregation, it should be observed, was not in the least degree diminished by the malignant misrepresentations of his enemies.

In the year 1701, Mr. Williams, after having been for some time a widower, married a second wife of considerable fortune and distinguished worth, who survived him.

During the reign of queen Anne he exerted himself, though ineffectually, in opposing the bills against occasional conformity, and for imposing the sacramental toll upon the dissenters in Ireland. In 1707 he used all his influence with his friends in Scotland in promoting the union between the two kingdoms; and in the year 1709 he was honoured with the degree of D.D. by the universities of Edinburgh and Glasgow. Availing himself of his long acquaintance with the earl of Oxford, he took the liberty of remonstrating against the political measures which he was purifying. The doctor's frankness did not please the statesman; and his remonstrance against him for declaring unfavourable sentiments of the ministers of his administration, and communicating them to his friends in Ireland, was deep and permanent. Upon the accession of king George I., he had the honour of presenting an address of congratulation to his majesty, at the head of the Protestant dissenting ministers of the different denominations residing in London and its vicinity; and it has been ever since the custom for the body of such ministers to present addresses on all public occasions, and they have the honour, as a body, of being received on the throne, and by their committees in the closet, and of receiving a written answer. Soon after the accession of George I., the health of Dr. Williams began to decline; and at length an apoplectic disorder terminated his life on January 26, 1715-16, in the 73rd year of his age. In the sequel of this article we shall take advantage of literally transcribing the well-written account given of Dr. Williams by the Rev. Mr. Morgan, the highly respectable and much esteemed librarian of the excellent institution which he has established; under whose inspection and care this library is gradually rising into a reputation, which, by the contributions of its friends in books and money, and by the annual appropriation of a small sum out of the surplus of its founder's bequests, will vie with the principal establishments of a similar nature in the city of London.

"He had been blessed by nature," says our biographer, "with a strong and vigorous constitution, and possessed a sound penetrating judgment, and great strength of memory. The subjects of his pulpit performances were always practical and useful; his sentiments solid, pertinent, and distinguished by an uncommon variety; and his manner of enforcing them powerful and impressive. He was remarkable for his boldness and courage in avowing and defending what he
he conceived to be truth of importance, and 'pursued what he thought right with a blunt integrity and unshaken resolution.' At the same time his candour towards those who differed from him, his kind treatment of persons who had endeavoured to injure his own reputation, and his conscientious tender regard for that of others, were prominent features in his character. He was a steady non-conformist upon principle; yet he maintained a charitable dispositions towards the established church, and at the Revolution was very desirous of promoting the scheme of a comprehension.

Though he possessed an ample fortune, he exercised great frugality in his personal expenses, for the noble purpose of being more useful to others who stood in need of assistance, and of more effectually serving the great interests of truth and virtue. The same laudable views governed him in the final disposal of his property. By his last will, besides liberal benefactions to numerous benevolent and charitable institutions in London and Dublin, he provided for the support of an itinerant preacher to the native Irish, of two persons to preach to the Indians in North America, and of several charity-schools in England and Wales. He directed that a certain fixed sum, from the income of his estates, should be appropriated to the assistance of poor ministers, the widows of poor ministers, students for the ministry, and to other benevolent purposes. He also left estates to the university of Glasgow, which at present furnish handsome exhibitions to fix students for the ministry among Protestant dissenters in South Britain, who are to be nominated by his trustees. The laft grand bequest in his will was for the establishment of a library in London, for the benefit of the public. Having formed this design, he purchased Dr. Bates's curious collection of books, which he added to his own, and directed his trustees to provide a proper building for their reception. Such an edifice was erected by them in Red-Cross-street, Cripplegate, where the library was opened in 1729, and admission to it is easily obtained by persons of every description, without any exception, upon application to one of the trustees. Since it was first established, very considerable additions have been made to it by legacies, as well as gifts of money and books; and it now contains upwards of 16,000 volumes, many of which are very valuable and rare, in the various departments of literature and science. The founder's works were collected together, and printed at different periods, in 6 vols. 8vo.; the last consisting of Latin versions of several of his tracts, which he directed to be published in that language for the use of foreigners.' Memoir prefixed to his Works.

WILLIAMSON, in Geography, a township of Pennsylvania, in Northampton county, with 1243 inhabitants; 60 miles N. of Easton.

WILLIAMSON's Port, a town of Maryland, on the Potomack; 5 miles S.W. of Hagers Town.

WILLIAMSON's River, a river of Vermont, which runs into the Connecticut, N. lat. 43° 10', W. long. 72° 24'.

WILLIAMSBOROUGH, a poll-town of North Carolina, on a creek which falls into the Roanoke; 48 miles N.E. of Hilliborough.

WILLIAMSBURG, a county of the state of South Carolina.—Alfo, a county of the state of Virginia.—Alfo, a town of Virginia, situated on an isthmus between York river and James river, a creek from each river coming up within a mile of the town, but not navigable for large vessels. It was at one time the seat of government and residence of the governor, now removed to Richmond. It contains about 200 houses, and 1200 inhabitants. The principal buildings are a college and town-hall, an episcopal church, and an hospital for lunatics; 50 miles E.S.E. of Richmond. N. lat. 37° 13'. W. long. 76° 50'.—Alfo, a town of Massachusettts, in Hampshire, with 1122 inhabitants; 8 miles N.W. of Northampton.—Alfo, a town of New York, on the Genesee; 288 miles N.N.W. of Philadelphia.—Alfo, a town of the state of Ohio, on the Little Miami, in the county of Clermont, with 1251 inhabitants.—Alfo, a town of Maryland; 4 miles N. of Talbot.

WILLIAMSBURG, or Jones-town, a poll-town of Pennsylvania; 23 miles E.N.E. of Harlirgton.

WILLIAMSON, a township of Ontario county, in New York, 266 miles from Albany, bounded N. and W. by lake Ontario. In 1810 the whole population consisted of 1139 persons, and it had 55 senatorial electors. A red oyx of iron is found in this town, which is a good pigment for painting.

WILLIAMSON, a county of West Tennessee, with 13,153 inhabitants, including 3085 slaves.

WILLIAMSPORT, a poll-town of Pennsylvania, on the west branch of the Susquehanna, in the county of Wyoming, with 344 inhabitants.

WILLIAMSTOWN, a township of the state of Vermont, in Orange county, with 1553 inhabitants; 60 miles N. of Norwich.—Alfo, a poll-town of New York, on the Mohawk; 55 miles W. of Cleveland.—Alfo, a town of Massachussetts, in the N.W. corner of the state, in the county of Berkshire, with 1843 inhabitants; 132 miles W.N.W. of Boston.—Alfo, a poll-township of Oneida county, in New York, erected in 1825, from a part of Mexico, and consisting of two townships of Scriba's patent, each being six miles square. The population in 1810 consisted of 562 persons, and 82 senatorial electors. The post-office was established in 1812.

WILLICHA, in Botany, was so called by Mutis, after Dr. Christian Lewis Willich, a physician at Clathual, in Lower Saxony, who published at Gottingen, in 1747, 1762, and 1766, various observations and illustrations of Botany, of more or less importance, chiefly relating to the determination of species and their synonyms, with cursory remarks on variations or irregularities of structure, exceptions to received characters, &c. The author died in 1776.

WILLIAMSTOWN, a township of the state of Vermont, in Orange county, with 1553 inhabitants; 60 miles N. of Norwich.—Alfo, a poll-town of New York, on the Mohawk; 55 miles W. of Cleveland.—Alfo, a town of Massachussetts, in the N.W. corner of the state, in the county of Berkshire, with 1843 inhabitants; 132 miles W.N.W. of Boston.—Alfo, a poll-township of Oneida county, in New York, erected in 1825, from a part of Mexico, and consisting of two townships of Scriba's patent, each being six miles square. The population in 1810 consisted of 562 persons, and 82 senatorial electors. The post-office was established in 1812.

crescent, hairy, an inch in diameter; reddish underneath. Flowerstalks very long, hairy, thicker than the stem. Flower-flax axillary, in pairs, single-flowered, thread-shaped, hairy, the length of the flowerstalks. Flowers small, rose-coloured, with a hairy calyx.

There is no specimen in the Linnean herbarium.

WILLISTON, in Geography, a post-town of Virginia; 242 miles S.S.W. of Washington.

WILLIMANTIC, a river of Connecticut, which runs into the Shattuck at Windham.

WILLINK, a large township of New York, at the S. end of Niagara county, erected in 1808; 315 miles W. of Albany. It comprises about eighteen townships of the Holland company lands. The general character of the soil is, that it is good land for farming. In 1810 the population consisted of 2028 persons, and there were 260 senatorial electors.

WILLING's CREEK, a river of West Florida, which runs into the Mississipii, N. lat. 30° 49'. W. long. 91° 21'.

WILLINGBOROUGH, a town of New Jersey, in Burlington county, with 619 inhabitants; 14 miles N.E. of Philadelphia.

WILLINGTON, a town of Connecticut, in Tolland county, with 1161 inhabitants; 6 miles E. of Tolland.

WILLIS, BROWNE, in Biography, an eminent antiquary, the grandfather of Dr. Willis, a celebrated physician, was born at Blandford in 1662, and was removed from Westminster-school in the year 1692 to Oxford, where he was admitted a gentleman-commoner of Christ-church; and after leaving the university he prosecuted his studies for three years under Dr. Wotton. When he came into possession of the family estate, he was returned in 1705 as a representative for the town of Buckingham. In 1715 and 1716 he published two parts of a work, intitled "Notitia Parliamentaria; or, a History of the Counties, Cities, and Boroughs in England and Wales, with Lists of all the Knights, Citizens, and Burgesses," 8vo., to which in 1750 he added a third part, being an appendage to the journals of the house of commons, then printed. On the revival of the Society of Antiquaries in 1717, he was chosen a member; and he sustained his reputation as an antiquary by various writings, amongst which are, "Surveys of the Four Welsh Cathedrals;" "History of the United Parliamentary Abbeyes and Conventional Cathedral Churches;" "Survey of the Cathedrals of England, with Parochial Anglicanum," 3 vols. 4to.; "History and Antiquities of Buckingham." In 1723 he received, in consideration of his literary merit, from the university of Oxford, the degree of A.M. by diploma. He manifested his attachment to the church by expending considerable sums in repairing those in the country, and thus injured his own fortune. But frugality in his personal and domestic expenses compensated this injury. He possessed a fine cabinet of English coins, which in 1741 he presented to the university of Oxford; the university, in consideration of his family, liberally paying for those of gold by weight, and conferring upon him the degree of L.L.D. With many peculiarities in his character, he claimed respect as a man of moral worth from those who knew him. To him belonged the honour of having first placed the English ecclesiastical history and antiquities upon the firm basis of records and registers, which he assiduously sought. He died in 1760, in the 76th year of his age. Biog. Brit.

WILLIS, THOMAS, an eminent physician, was born in 1622-3, at Great Bedwin, in Wilts; and in 1656 admitted into Christ-church college, Oxford, where he took the usual degree with a view to the clerical profession. But he changed his purpose, and studied physic, taking his bachelor's degree in 1658, and commencing medical practice at Oxford. He distinguished himself by his steady attachment to the church of England, and also by his love of science, so that he became one of the first members of that philosophical society at Oxford, which laid the foundation of the Royal Society of London. As a chemist, which was the character under which he was ambitious of excelling, he published in 1659 a work, intitled "Diatribe de quinacria; prior agit de Fermentatione, altera de Phæbus. His accedidit Differtatio Epistolica de Urinis." The recompense of his attachment to the cause of episcopacy and loyalty was the Sedleian professorship of natural philosophy at Oxford, conferred upon him after the Restoration, by the recommendation of archbishop Sheldon, soon after which he received the degree of doctor. Upon the establishment of the Royal Society, he was one of its first members. In the year 1664, when he was on the point of being discovered, and brought into use, the mineral water of Attop in Hampshire, he published his "Cerebri Sanequ; quic accedent Nervorum Defertitio et Ufina." This work, on which his reputation principally depends, was followed in 1667 by his "Pathologia Cerebri et Nervi Generis, in qua agitur de Morbis convulsivis, et de Scorbuto." Before this year he was settled in London, and being nominated a physician in ordinary to the king, was advancing to the first rank in practice. His next publication was intitled "Adfcriptionem quanti dicaturus Hypherae et Hypochondriacae Pathologia Spafmodica, vindicata contra refpoumonem epistolarem Nanth. Highrneri. Cui acceduerunt Exercitationes Medicas, Phycicae de Sanguinis Accensione, et Motu muculari," 1670. On occasion of the loss of his wife, a daughter of dean Fell, he amused himself by writing his work "De Animae Brutorum que Hominis Vitalis ac Senitiva et Exercitationes duce," 1672, in which he considers the soul of brutes as the same with the vital principle in man, corporeal in its nature and perishing with the body. After his second marriage, he began to print in 1673 his "Pharmaceutica Rationalis, sive Diatribe de Medicamentorum Operationibus in Humano Corporis;" but he did not live to publish this work, as he was carried off by a pleurisy in 1675, at the premature age of 54, in the full vigour of his faculties and zenith of his reputation. Dr. Willis had no powers for appearing with advantage and brilliancy in society; but he was intent on science and practice, frugal, pious, and charitable. His works engaged great attention on their first publication; but in consequence of modern improvements, they have sunk in the public estimation, though they are not altogether neglected. They are written in a rich and elegant Latin style. Haller. Biog. Brit.

WILLIS, in Geography, a town of the state of New Jersey; 33 miles S.E. of Burlington.

WILLIS's CREEK, a river of Virginia, which runs into James river, N. lat. 37° 40'. W. long. 78° 18'.

WILLIS'S ISLAND, a small island in the South Atlantic ocean, near the north-west coast of the island of Georgia, so named by captain Cook, from one of his crew who discovered it in the year 1775. S. lat. 54°. W. long. 38° 25'.

WILLISAU, a town of Switzerland, and capital of a bailiwick, in the canton of Lucerne; 15 miles W. of Lucerne.

WILLISTON, a post-town of the state of Vermont, in the county of Chittenden, with 1195 inhabitants; 25 miles N. of Newhaven.

WILLISTOWN, a township of Pennsylvania; 15 miles S.W. of Philadelphia.

WILLMAR, a town of the county of Hesseberg; 7 miles S.E. of Meinungen.
WILLOBOCKE, a river of Yorkshire, which runs into the Swale.

WILLONGTALYS, a lake of Vermont. N. lat. 44° 45'. W. long. 71° 58'.

WILLSHAW, a town of England, in the county of Warwick, situated on a navigable canal, on the borders of Northamptonshire; 14 miles S.E. of Coventry.

WILLSHAW Bay, a bay on the south-east coast of the island of Antigua. N. lat. 17° 10'. W. long. 61° 25'.

WILLSHAW Lake, a lake of the state of Vermont.

WILLOW, &c., in Botany. See SALIX.

Our common willows in the spring season, when they are in flower, produce a quantity of cottony matter, which might be put to some use.

The Chinese are industrious enough to collect this cotton as it falls from their willows; and the women and children, among the poorer people, card it, and pick out the seeds, and render it fit for many uses in the place of cotton.

The poor people, in some part of the Indies, make a fort of liquor of the flowers of their willows before they are opened, which intoxicates them very suddenly; and the dry hulls of the same tree remaining after the flowers and seeds are fallen, are wholesome as food, people in time of famine having lived upon them, boiled in water.

The wood of the willow, though in itself very light and fpongy, is yet of a nature to bear the injuries of wet better than almost any other kind. It is used by the Chinese on this occasion, in the making of their wells, and on all other occasions where wood is to stand under water, and succeeds perfectly well. Observ. sur les Coutumes de l'Asie. For the uses to which willow-bark and wood are applied, see SALIX, and GUNPOWDER.

WILLOW, in Agriculture, a well-known tree, of which there are several different species or kinds; but those mostly cultivated for farm purposes are, the common white willow, the purple or red willow, the fallow, and the broad-leaved or Huntingdon willow.

The first is a tall-growing tree, of the deciduous kind. It has a fine silvery appearance in the leaves; is quick of growth, and the wood is very useful where lightness and cleanness of the grain is beneficial, as for hurdles, gates, hop-poles, &c.

The second is a free-flowering willow; but its wood is inferior for many uses, especially those of the farmer.

The third fort delights in a rather dry soil, being a tree below the middle growth. It has numerous branches, of a smooth appearance, and dark green colour. Its wood is very useful for hurdles and other similar purposes of the farmer.

It has two varieties, the long-leaved, and the striped fallow, both which are very useful.

The fourth, or red-hearted willow, is supposed by some as the best fort for planting, for the use of the farmer, as growing quickly; but the great use to which they are applied is that of making hurdles, stakes, gates, and farming implements, being a wood uncommonly tough and light, owing, as is conceived, to a new method used in planting them close to the ground. If it is the design of the planter to let them grow into timber, (which would be far superior to deal for the purpose of flooring, or other light work, particularly as it will neither splinter nor fire; and if suffered to remain for twenty or twenty-five years, would make good masts for small craft, as they shoot up perfectly straight, and without any collateral branches,) it is necessary, at the first or second year's growth, to observe which pole is the strongest, as the remaining poles must be cut away. In about fifteen years' time it is supposed they will want thinning; of course the inferior must be taken out and the superior be suffered to remain.

In cultivating them on walle moist lands, laying out the ground into lands, like hop-lands, as from three to four yards wide, with a ditch on each side; three feet wide at the top, one foot at the bottom, and two and a half deep, is advised by a late writer as the best mode from much experience. The earth that comes out of the ditch should be thrown on the land. But if there is not fully sufficient fall for the water to get off, the ditch should be deeper and wider, till there is near a yard of earth above the level of the water. As soon as this is done, the ground must be double ploughed, that is, trenched two spades' depth, except it be very boggy, which will afford room for the plants to shoot, and will save the expense of weeding, which otherwife must be incurred in the first summer after the plants are set; for if they are not kept clear of weeds the first year, the hopes of the planter will certainly be destroyed.

In respect to the times of planting, they must be from January to the end of March; but the fets for that purpose should be cut from December to the end of February, when the sap is down. And the reason is, that if poles are cut in the spring (the sap being up), the fow will at least be weakened by bleeding, if not killed; and of course prevented from shooting so vigorously as if cut at the preceding time.

In regard to the fets or truncheons, they may be cut from twenty inches to two feet long; particular care should be taken in the cutting, that the bark be not friged or bruised, or in any other respect injured; for in that case the fow will be weak and puny.

The poles have been sold at eight years' growth for 214l. per acre, net-money; the kids or brushwood pay for the felling. Had they been suffered to have fow two years longer, they would, it is said, have produced 300l. per acre.

The plantation of the balket and cooper's willow is an object of importance in those walle and neglected corners which are to be found upon every estate and farm.

The refuse dwarf willows or offal, as it is termed, are used in the fisheris and balket-work, and will pay, comminibus annis, for the labour. The cooper's willow differs from the common or balket-willow; the former is known by a single bud or eye throughout the rod, which simply throws out a leaf; the latter by a double or flattened eye, which produces a branch or sprig. The former is applicable to every purpose; the latter the cooper rejects: of course the former should be propagated.

Plantations of the willow kind have been vastly increased, indeed, in many parts of the country within these few years.

WILLOW-GALLS, in Natural History, the name given by authors to certain protuberances found very frequently on the leaves of the several species of willow, which are properly galls, each containing the worm of a fly, and owing its existence to that insect.

The galls are usually of a roundish or oblong figure, and are equally protuberant on each side of the leaf: they are of a pale green at first; but they afterwards become yellowish, and finally reddish. The surface of these is seldom perfectly even, but usually has several little prominences and cavities in it. When this gall is opened, there is found in it a worm resembling a caterpillar in figure, having a smooth annulated body, a hard brown head, and twenty legs; and by Reaumur called falfe or ballard caterpillar. This creature, when the gall is young, is blue; it afterwards becomes greenish; and finally, when the gall becomes red, it is white. This insect seems to eat in its prison more voraciously than any
any other gall-infect whatever; for while the gall grows in size, it becomes also thinner in every part; so that the creature, at the proper time, has but little difficulty to get out. Foraum. Hift. Insect. vol. vi. p. 211.

When the time of the last change of this infect draws nigh, it leaves the tree, and defending to the earth makes its way into it in a proper place, and then becomes a nymph, out of which at a proper time issues a four-winged fly.

The flies which are produced in April copulate almost as soon as freed from their exuviae of the chrysalis state, and the females soon after lodge their eggs in the leaves of the willows. This is all done before the end of April, and the young ones hatched from these eggs live but a short time before they pass into the chrysalis state, and flying flies are hatched from these in June. The young ones of this brood pass their chrysalis state in the earth, and appear not during the whole winter, till the spring fun enlivens them again. There is, beside these, another kind of galls of the willow-leaves, which are of the class of those, each of which contains several cells; in each cell of these there is found a small white maggot, the offspring of the egg of a two-winged fly, which, after passing the chrysalis state in the earth, also comes out in the form of its winged parent. The cells in the galls are different in number in the several galls, and are from four or five to twenty: they have no communication with one another, but each worm lives in its own cell.

Beside these there is also sometimes found in these galls a worm of a brownish-white colour, having two hooks in its head, and no legs at all. This has all the appearance of a carnivorous animal, and probably was deposited there in the egg-state by its parent, not to feed on the gall, but on its defenceless inhabitant. This worm finally becomes a small blue-colored beetle, and is often found alone in the cavity of the gall, often in company with its proper inhabitant, feeding on its juices as it feeds on those of the plant. There seem to be several species of these devourers common to these galls; since Vallisneri observed, in the boxes where he kept these galls to produce the animals from thence, many species of small beetles, and several distinct kinds of flies, which were probably the last state of several kinds of carnivorous worms, which had preyed upon the proper inhabitant of the galls. Vallisneri, Dialog. des Insect.

EPILOBII, or French Willow, in Botany. See EPILOBIUM.

WILLOW, or French Willow, in Botany. See EPILOBIUM.

WILLOW-HERB, or French Willow, in Botany. See EPILOBIUM.

WILLOW, Sweet, Dutch Willow, Gale, or Candle-Berry MYRTLE, in Botany. See CANDLE-BERRY TREES, and CANDLE-BERRY MYRTLE.

WILLOW-WOOD, in Agriculture, a term provisionally applied to smart-weed, or percirica, which is a troublesome weed on many places in the corn-fields and other tilage-lands. See WeED.

WILLS, in Geography, a town of Ohio, in the county of Guernsey, with 659 inhabitants.

WILLSBOROUGH, a post-township of Essex county, in New York, with a post-office, 530 miles from Walling- ton, erected in 1778, then in Clifton county, and very extensive; from which several towns have been since created. It is bounded N. by Chesterfield, E. by lake Champlain, in the state of Vermont, S. by Essex, and W. by Lewis. Along the lake the land is level and tolerably productive. A small well-drain affords many fites for water-works; and iron ore of the best quality is found in great abundance. The population consists of 668 persons, and the senatorial electors are 57. Here are, one distillery, a forge for making bar-iron, an anchor-shop, a carding-machine, and a clothier, besides a considerable number of grain and saw mills.

WILLSBOROUGH, a township of New York, near Crown Point.

WILLSTADT, a town of Sweden, in the province of Smaland; 50 miles W. of Wexio. — Also, a town of Germany, in the county of Hanau Lichtenberg; 7 miles S.E. of Strafsburg.


Gen. Ch. Cal. Perianth inferior, of one leaf, fleshy, in five deep acute segments, very small. Cor. of one petal, faver-shaped: tube cylindrical, enlarged at the bottom: limb horizontal, in five deep, oblique, acute, wavy, segmental, more dilated at one side than the other, lying over each other at the base. Stam. Filaments five, very short, inserted into the tube just above the base; anthers arrow-shaped. Fl. German superior, roundish: style quadrangular; Stigma capitata, ovate, thick, fringed, double-pointed, subtended by a flat orbicular disc. Peric. Berry ovate, coated, of one or two cells. Seeds numerous, angular, compressed, imbedded in pulp.


1. W. acida. Acid Willughbea. Willd. n. 1. (Amelabia acida; Aubl. Guian. 266. t. 104.)— Stem erect. Flower-flakes the length of the foot-flakes.—Native of extensive forests in Guiana and Cayenne, bearing flowers and fruit in September. The trunk of this tree is feven or eight feet high, and seven or eight inches in diameter, with a greyish bark, and soft white wood. The seed-flakes of very numerous, straight, knotty branches, subdivided in an opposite manner. Leaves opposite, on short flaxes, elliptical, somewhat pointed, entire, wavy, smooth and shining, with one rib, and many transverse parallel veins; their greatest length seven inches, by three in breadth. Flowers axillary, three or four together on one common inflorescence, which is hardly so long as the adjoining foot-flake. Bracteas scaly, solitary, at the base of each general as well as partial flake. Corolla whitish, scarcely so large as that of Vinca minor. Fruit yellow-coloured, oval, succulent, or warty, two inches long, separated by a longitudinal fleshy partition, into two cells, filled with acid viscid pulp, and containing many brown rough seeds. This fruit, though milky, is wholesome. After the rind is taken off, the remainder is foaked for a while in water. The flavour is agreeably acid, notwithstanding a great degree of viscidity, by which the pulp adheres to the lips and teeth. The fruit with or without its rind, is preferred in fugar. In the latter flate it is cooling, slightly acid; in the former moderately purgative, and efficaciously useful in dysenteries. The whole plant when wounded discharges a milky, very tenacious juice.

WIL

Native of woods about the mouth of the creek of the Galbis in Guiana, bearing flowers, as well as fruit, in May. The trunk is about three inches in diameter, fending long, knotty, trailing branches, which twine round the neighbouring trees to their very summits, from whence the extremities hang down, clothed with opposite, oval, smooth, entire leaves, not unlike the foregoing, and about as large, on short flanks; their rib, as well as lateral veins, are prominent and reddish. The flower-flanks are axillary, solitary, wavy, alternately branched, refembling tendrils, terminating in several long tufts, or umbels, of yellow flowers, rather smaller than the first species. Fruit roundish or obovate, the size and colour of a guinée, of an agreeable scent when ripe, pulpy, yielding but a small quantity of milky juice if cut, though all the other parts of the plant contain a great quantity of the same kind of glutinous milk as the preceding. Aublet does not mention any use to which this species, or its fruit, is applied.

WILLUGHBY, Francis, in Biography, was born in 1635 of a good family in Lincolnshire, and educated in Trinity college, Cambridge, under the tuition and in habits of friendly intercourse with the excellent philosopher and natural historian, John Ray. They were intimate associates, and made a foreign tour together in the years 1663 and 1664. To birds and fishes Willughby paid particular attention, and he formed a rich museum of animal and fofile productions. In 1668 he married the daughter of Sir Henry Bernard, and his family residence at Middleton, in Warwickshire, was the place of Ray's frequent refor, where he and his host prosecuted their philosophical experiments and observations, the result of which they communicated to the Royal Society, of which they were both members. This instructive and pleasant intercourse was, however, prematurely interrupted by the death of Willughby in 1672, at the age of 37. His confidence in Mr. Ray was manifested by appointing him one of his executors, and committing to him the charge of educating his two infant sons, bequeathing to him an annuity for life as a compensation. Ray acquires to him, without any trace of adulation, singular moral excellence and high mental endowments. His polished and elegant writings, published under the inspection of Mr. Ray, was entitled "Francisci Willughbi Arm. Ornithologiae Libri tres; in quibus Aves omnes haecetenus cognitae, in methodum natura suis convenientem redactae, accuratim describuntur. Descriptiones iconibus elegantissimis et vivarium avium similiis æxi incisulis illustrantur. Totum Opus recognovit, digestit, supplevit Johannes Raus," Lond. fol. This work was also translated into English by Ray, and published in 1671 with large additions. Mr. Ray also collected and arranged Willughby's papers on Ichthyology. He added the two first books, and with the assistance of the Royal Society published them in 1686 under the following title: "Franc. Willughbi Arm. de Historia Fisium, Libr. quatuor, jussu et fumptu Soc. Reg. Lond. editi. Totum Opus recognovit, coacapit, supplevit librum etiam primum et secundum integros adjuncti J. Raus." Oxon. fol. The papers of Willughby in the Phil, Trans. relate to vegetation, plants, and insects. The collection of Ray contains none of his letters. Biog. Brit. Pulney's Sketches of Botany.

WILLY, in Geography, a river of England, which runs into the Avon, near Salisbury.

WILLYKA, a town of Lithuania, in the patinate of Wilna; 60 miles E. of Wilna.

WILMANSTRAND. See Wilmanstrand.

WILMANTON, a town of New York; 50 miles N. of New York.

WILMINGTON, a sea-port town of the State of Delaware, on Brandywine Creek; 22 miles S.W. of Philadelphia. N. lat. 39° 45'. W. long. 75° 34'.—Also, a sea-port town of North Carolina, with about 250 houses, on a branch of Cape Fear river. In January 1781, this town was taken by the British troops; 76 miles S.S.W. of Newbern, N. lat. 34° 11'. W. long. 78° 5'.—Also, an island near the coast of Georgia, at the mouth of the Savannah. N. lat. 32°. W. long. 81° 6'.—Also, a town of Vermont, on Deerfield river, in Windham county, with 1193 inhabitants; 10 miles E.-S.E. of Bennington.—Also, a town of Massachusetts, in the county of Middlesex, with 716 inhabitants; 16 miles N. of Boston.—Also, a town of New York; 53 miles N. of New York.

WILMOT, John, in Biography, car of Rocheller, was the son of Henry, earl of Rocheller, an eminent loyalty in the reign of Charles I., and was born in 1647, at Ditchley, in Oxfordshire. In 1659 he was entered at Wadham college, Oxford, and afterwards travelled into France and Italy under a tutor, who is said to have reclaimed him from his early licentiousness; but upon his return to the profligate court of Charles II., in which he was a gentleman of the bed-chamber, he relapsed into his former intemperance. In 1666 he went to sea, and, as it is said, behaved with great intrepidity in the attack of a castle at Bergen, in Norway, which character for courage he also maintained when he afterwards served under Sir Edward Spragge. In some of his domestic adventures, however, he forfeited this kind of reputation. Welcomed in all companies on account of his wit and vivacity, he became habitually intemperate, inso much that, on a subfrequent review of his conduct, he acknowledged that for five successive years he was never free from the inflaming effects of wine. His various adventures, in his real, or in a disguised character, have furnished many anecdotes, that have been circulated in conversation, or in books of mere amusement, but which are not worth recording in graver publications. His wit furnished in the societies which he frequented a kind of apology for his profaneness and licentiousness; and as for his poetical compositions, they were for the most part lampons or amatory effusions, the titles of which would flain the page of biography. "In all his works, (says Dr. Johnson, meaning probably those which can be read,) there is sprightliness and vivacity, and every where may be found tokens of a mind which study might have carried to excellence." The justice of Walpole's sentence, in his "Catalogue of Noble Authors," will be generally allowed: "Lord Rocheller's poems have much more obscurity than wit, more wit than poetry, more poetry than politeness." His course of debauchery was of no long duration; for soon after the age of 30 he sunk into a state of debility and diseae, which induced him to study physic, and this study permitted him to reflect on the course of his past life, the irremediable effects of which he learnt from experience. Towards the close of his short life, he became acquainted with bishop Burnet, who convinced him of the truth both of natural and revealed religion, and his mind was then impressed to such a degree, that he is said to have become a sincere penitent. His life terminated in July, 1689, soon after he had commenced his 33d year. He left a son and two daughters. Biog. Brit. Johnson. Burnet.

WILMOT, in Geography, a town of Nova Scotia, near Annapolis.—Also, a town of New Hampshire, in the county of Hillsborough, with 298 inhabitants.

WILNA, a city and capital of the duchy of Lithuania, on the Wilna, founded in the year 1305. This city lies in a mountainous country, on several little eminences. It is very
very large, and has two considerable suburbs, called Antokolla and Rudaifzka. In the old ruined royal palace is the arsenal, and the hall where the court of justice is held; and over-against it is the magnificent church belonging to the castle, which was built in the year 1386. The treasury belonging to this church is very rich; and it is also remarkable for the elegant marble chapel of St. Casimir, whose silver shrine is said to weigh thirty quintals. There are upwards of forty churches in this city, and among these are, one Lutheran and one Calvinist church, a Jewish synagogue, a Tartarian church, and a Greek church; but all the rest are Popish churches. Not to mention the devastation which Wilna formerly suffered from the Russians in the years 1610 and 1655, and from fire in 1737, it was destroyed by a dreadful conflagration in the year 1748, when 13 churches, the Jewish synagogue, 25 palaces, 460 stone edifices, consisting of private houses, hospitais, inns, baths, convents, and mills, with 146 tradesmen's shops, and dispensaries, besides a great number of granaries and warehouses, were consumed to ashes. In 1749 another fire happened by lightning, which consumed 6 churches, the council-houfe, 8 palaces, and 277 other stone buildings. The chapel of St. Casimir was also burned, and the loss sustained by the destruction of this edifice only amounted to a vast sum. The churches have been since rebuilt at a very great expense, and some of them in a more elegant manner than before; but the city has not recovered its former grandeur. Wilna is the seat of a bishop, founded in 1387. The university was founded in 1570. It gives name to a palatinate. In 1794 it was taken by the Russians, and with its territory annexed to that empire; 168 miles E. of Königsberg. N. lat. 54° 36'. E. long. 25° 18'.

WILRE, a town of France, in the department of the Ourthe; 4 miles E. of Fauquemont.

WILS, a town of the county of Tyrol, on the borders of Bavaria; 5 miles N.N.W. of Reutten.

WILSCHOE, a river of Brandenburg, which empties itself into a large lake, communicating with the Rega, 4 miles S. of Treptow.

WILSDEN, a township of England, in the West Riding of Yorkshire, near Halifax.

WILSDORF, or WILSDORF, a town of Saxony, in the margravate of Meissen; 9 miles W. of Dresden. N. lat. 51° E. long. 13° 8'.

WILSELM, a town of Austria; 3 miles W. of Brugg.

WILSNACH, a town of Brandenburg, in the Mark of Prignitz. This town was anciently famous, there being no less than three hofts worshipped at this place, which hofts they fay, in 1383, remained untouched in the church when it was burned down, and upon each of them was feen a drop of blood. To thefe hofts numerous pilgrimages were made from the remotest countries; by which means this place rofe from a village to a mall town. At length the hofts were burned in the year 1552, by the Lutheran preacher, Joachim Ellesfildt; 8 miles S. of Perleberg.

WILSON, Richard, in Biography, the moft eminent landscape-painter of the English school, was the fon of a clergyman, and was born at Pineses, in Montgomeryshire, in 1714.

Having received from his father a good classical education, in the course of which he had evinced a decided disposition for drawing, he was sent to London at the age of 15, and placed as a disciple with an obscure portrait-painter, named Wright. After a lapse of six years, he commenced professor, and under the patronage of Dr. Heyter, bishop of Norwich, he soon afterwards had the honour to paint portraits of his present majesty and his brother, the late duke of York; both at that time under the tuition of the bishop. He continued to pracitife portrait-painting some time in London, but with no great successes, and at length went to Italy to cultivate his taste. Even there he continued to pracitife it, still unacquainted with the genuine bias of his genius, although occasionally exercising his talents and employing his time in studies of landscape. At Venice Wilfon painted a portrait of the late Mr. Lock, of Norbury-park, one of the moft creditable of his performances in that branch of the art; and it was there that accident opened his eyes to his own peculiar gratifications, and led him into that path, by pursuing which he has obtained a name among the worthieft in art.

As a matter of relaxation and amusement, he had painted a landscape, which being seen by Zuccarelli, so warmly excited that eminent artist's admiration, that he advised Wilfon to pursue that line of art exclusively. From this time it is believed that he abandoned portraiture, and followed the judicial advice of a rival artist; and soon after he left Venice in company with Mr. Lock, and travelling slowly to Rome, made numerous studies on the way, which are still preferred at Norbury-park. On his arrival at Rome, the advice of Zuccarelli was confirmed by Vernet and Mengs, both then in high repute. So much were they delighted with Wilson's landscapes, that they each offered to exchange a picture with him; a proposal far too flattering for refusal. This liberality, as commendable as it is unusual, was followed by Vernet in the handomest manner, as he hung the picture by the Englishman in his exhibition-room, and recommended him to the particular attention of the connoisseurs.

His progress in landscape-painting must have been very rapid; indeed it must have had the character of being almost intuitive, since he obtained a very great degree of reputation during his stay in Italy, and painted many pictures there of known celebrity. He travelled with the late earl of Dartmouth to Naples, and made a number of very fine drawings for that nobleman, now preferred by his grandson; and for him also he painted two pictures, one a very fine one, a view of Rome, which has been beautifully engraved by middiman. He was also employed by the late duke of Bridgewater to paint a landscape with the story of Niobe; but his grace had the bad taste to employ Placido Constanza to re-paint the figures. To preserve his reputation, Wilson painted another of the same subject, and both are now in England. He returned from Italy in 1755, and occupied apartments over the north piazza of Covent-Garden. He had merited, and here he also obtained celebrity, and for a while employment. Many of his principal performances appear to have been painted about this time, most of which are known by the fine prints engraved from them by Woollett, and others; in which the grandeur, breadth, and purity of composition in maps and in line, contend for admiration with the talents conspicuous in the engravings.

Hitherto the life of Wilfon was honoured as his talents deferred; the remainder of it exhibited a gradual declension, not so much of power as of patronage. 'Tis true he was often too free in his pencil, and too much mannered in his style; repeating himself, perhaps, till it became irksome; 'tis said, also, that he was not of the most tractable humour, and was low in his pursuits and associations. Whencesoever it arose, he was doomed to undergo indifference and neglect, and consequently the inconveniences of lowness of purse. Sometimes he was employed to paint views of gentlemen's seats, but probably the occupation suited the artist as little as the result gratified the patron. Wilson's view of nature was far too broad for suitable adaptation
adaptation to such a purpose, and consequently there are not many pictures of this class to be met with which have proceeded from his pencil. The great characteristic of his works is grandeur, resulting from breadth, purity, and simplicity, united in fullness of colour and mellowness of touch. He was perfectly original in feeling and execution, more grand in general conception than Claude, though infinitely less perfect in detail; and far from travelling through his career in art, with so even a pace as his great predecessor and only rival in the more exalted style of landscape-painting before our time. Now a third shines in the same hemisphere, and Claude and Wilton find no ill-fated associate in the name of Turner.

At the institution of the Royal Academy, Wilton was chosen one of the founders; and after the death of Hayman he was made librarian. That station he sustained till his death, which happened in May 1782, in the 68th year of his age.

WILSON, Thomas, an English prelate, was born in 1663, at Burton-in-Wirral, Cheshire, and finished his education in Dublin college, where he took his degree of arts. In 1689 he was ordained priest, and in 1692 became domestic chaplain to the earl of Derby, and attended his son, lord Strange, who was his pupil, on a tour to the continent. Upon the death of the young gentleman, he returned to England, and in recompense of his faithful services, was nominated to the bishopric of the Isle of Man, by the earl of Derby, who then possessed sovereignty of the island. The nomination was approved by king William, and he was consecrated in January 1697-8, having received at Lambeth the degree of LL.D. The revenue of the bishopric did not amount to more than 360\text{\$/a} a year; but by some collateral advantages the bishop was enabled to exercise hospitality and charity, to repair his ruined palace, and to found a new chapel at Castletown. He also established parochial libraries, which he furnished with religious books, among which was a small tract, the first that was ever printed in the Manx language. He improved the agriculture of the island by introducing into it corn, borches, cattle, and sheep, from England; and he studied physic with a view of administering to the relief and comfort of the islanders. He published ecclesiastical constitutions, which were so much approved, that lord chancellor King laid them of, that "if the ancient discipline of the church were left, it might be found in all its purity in the Isle of Man." Bishop Wilton, chiefly with a view to the interest of religion and morality, was anxious to maintain a due regard to episcopal authority, and this anxiety led him in two instances to exceed the bounds of prudence and propriety. When some copies of the "Independent Whig" had found their way into the island, he ordered them to be seized, apprehending that they incited sentiments hostile to Christianity and the established church. He also involved himself in difficulties and incurred reproach by excluding from the communion the wife of the governor, on account of an act of defamation, for which the refused to ask pardon of the injured party. This led to a serious altercation with the governor, who fined both the bishop and his two vicars-general, for suspending his chaplain for disobedience in admitting the wife to communion, and who arrested them for refusing to pay the fine. Accordingly they were kept close prisoners in the castle for nine weeks, till the bishop, by application to the council in England, obtained their release. The pious and mild-tempered bishop afterwards declined prosecuting the governor for damages. From his piety and attachment to the church, he was honoured in 1707 with the degree of D.D. from the university of Oxford, in full convocation, and in which he was afterwards aggregated at Cambridge.

Such was the bishop's zeal for doing good, that he would not quit the sphere assigned him for this purpose, though he was offered an English bishopric; in reference to which circumstance queen Caroline, directing her attention to Wilton, among a number of other prelates who happened to be at court at the same time with him, said to them, "Here, my lords, comes a bishop whose errand is not to apply for a translation, nor would he part with his spouse because she is poor." His character was in such estimation with the French minister, that he procured an order that no French privateer should commit ravages on the Isle of Man. In this retired situation his life was prolonged to his 93d year, when he calmly expired in March, 1755, leaving one surviving son, known in the political world as lord St. Stephen's, Walbrook, and patron of the celebrated historian Mrs. Macaulay. After his death a collection of his works was published in two vols. 4to. 1781. His notes to Cruikshank's Bible, which was published under the bishop's name in three vols. 4to. 1785, are of little value. The translation of the New Testament into the Manks language, which he had undertaken, was completed by his successor, Dr. Mark Hillelsey. Biog. Brit. Life prefixed to his Works. Gen. Biog.

WILSON, Dr. John, a native of Feverham, in Kent, was a gentleman of Charles the First's chapel, and servant in ordinary to his majesty, in the character of chamber-musician. His instrument was the lute, upon which he is said to have excelled all the Englishmen of his time; and, according to Ant. Wood, his royal master was so pleased with his talents, and had even such a personal regard for him, that he not only listened to him with the greatest attention, but frequently condescended to lean or lay his hand on his shoulder, while he was playing.

For the excellence of his performance we must now wholly depend on tradition, as the compositions he has left behind him for the lute are but feeble testimonies of a great hand. Nor will his vocal productions, or Fantasias, either in print or manuscript, generate very exalted ideas of his genius or abilities as a compositor. That he was admired by his majesty, and by the lovers of music at Oxford, where he was honoured with the degree of doctor in music, 1644, and where he long resided, proves more the low state of the art at this time, before the ears of the public were rendered discriminative, by a variety of great and rival talents, than his own perfections. Little had been heard, but but little was expected. Swift says, "we admire a little wit in a woman, as we do a few words spoke plain by a parrot;" and it might more seriously be said, that the best music, during times of ignorance and inexperience, is perhaps more admired than the most exquisite productions and performance of a more enlightened period. Nothing can prove this more clearly than the unbounded and hyperbolical praises bestowed in France on the operas of Lulli, of which, at present, the whole nation is ashamed.

Dr. Wilton, indeed, seems to have set words to music more clumsily than any composer of equal rank in the profession; but as he was respected by his contemporaries, and held an exalted rank in his art, a lift shall here be infected of his works; not so much for their intrinsic worth, as to enable curious enquirers to judge for themselves of the progress which music had made in this kingdom, when such productions were in high favour, not only with the greatest personages but principal professors of the times.

"Psalterium Carolinum, the devotions of his sacred majesty.
jealous in his solitude and sufferings, rendered in verse, set to music for three voices and an organ or theorbo.” Folio, 1667.

“Cheerful Aires or Ballads, first composed for one single voice, and since set for three voices.” Oxon. 1660.

“Aires to a voice alone, to a theorbo or bafs viol,” these are printed in a collection entitled “Sele&aire and Dialogues.” Folio, 1653.

“Divine Services and Anthems,” the words of which are in Clifford’s Collection. Lond. 1663.

He also composed music to several of the odes of Horace, and to some select passages in Aufonius, Claudian, Petronius Arbiter, and Statius; these were never published, but are preserved in a manuscript volume curiously bound in blue Turkey leather, with silver clasps, which the doctor presented to the university, with an injunction that no person should be permitted to peruse it till after his decease. It is still among the archives of the Bodleian library.

The compositions of Dr. Wilfon will certainly not bear a severe scrutiny either as to genius or knowledge. It is, however, not easy to account for the ignorance in counterpoint which is discoverable in many lutenists of these times; for having harmony under their fingers, as much as the performers on keyed instruments, it facilitates their study, and should render them deeper contrapuntos than the genericity of flute-players, whose flimsy compositions are proverbial.

On the surrender of the garrison of the city of Oxford, 1646, Dr. Wilfon left the university, and was received into the family of Sir William Walter, of Sarfen, in Oxfordshire; but, in 1656, he was constituted music-professor, and had lodging assigned him in Balliol college, where, being assisted by some of the royalists, he lived very comfortably, exciting in the university, according to A. Wood, such a love of music, as in a great measure accounts for that flourishing state in which it has long subsisted there, and for those numerous private music-meetings, of which this writer, in his own life, has given such an amusing relation. At the restitution of his kingdom, Dr. Wilfon was appointed chamber-musician to Charles II. ; and, on the death of Henry Lawes, 1663, was again received into the chapel-royal, when, quitting the university, he resided constantly in London, till the time of his decease, at near 78 years of age, in 1673. Burney.

**Wilson**, in *Geography*, a town of South Carolina; 15 miles S.W. of Queenborough. — Also, a town of Scotland, in the county of Lanark, founded in the latter end of the 18th century, by Melfes. Wilfon of London, to accommodate the workmen employed in an iron foundery there; 5 miles E. of Lanark.—Also, a county of West Tennessee, with 11,952 inhabitants, including 2397 slaves.

**Wilsonia**, in *Botany*, received that appellation from Mr. R. Brown, who commemorates it by the remarkable zeal and perseverance of Mr. John Wilson, an inhabitant of Kendal, Westmoreland, author of a “Synopsis of British Plants in Mr. Ray’s Method,” published at Newcastle-upon-Tyne in 1744. This work, however, is incomplete, the grasses, trees, shrubs, and all the cryptogamic tribe, except ferns, being omitted. The author, whom Dr. Pulteney supposes to have died about the year 1750, is said to have left these clafses unfinished in MS.; but they were never published. His performance indeed is now altogether oblolete, being chiefly translated from Ray and Tournefort; though with some alterations of the system of the former, and much additional matter, respecting the situations of rare plants; all which evinces a considerable portion of practical knowledge. Copious medical information is interspersed, and a botanical dictionary is prefixed. But the botanists of whom we are speaking is principally worthy of memory, for that indefatigable love of science, which even the most humble situation, and the most limited circumstances, could not counteract. Whether he was employed in the manufacture of knitted stockings, formerly very extensive in his native town, or whether he made shoes, his biographers are not agreed; but he contrived to attain more knowledge, and cultivation of mind, than perhaps a great majority of the gentry around him. He must have had a competent acquaintance with Latin, and he may rank as an English writer among the most respectable, upon scientific subjects, in his time. We cannot commend his prudence, if we commis- sionate his difficulties, when he would have sold his only cow, the support of his wife and family, to buy a copy of Morison’s work. But we may be allowed to regret that his mental application did not tend to so ample a pecuniary reward, as that of the famous sir Richard Arkwright, who repeatedly incurred the cenfure of many a prudent friend, for neglect of business, while he was planning a scheme of unbounded profit for himself and family. We rejoice to read that the book so much defired, was presented to Wilson by a benevolent lady, who lived near him, and who by this act has afforded a lasting testimony to the worth of his character. An honest man may always hope for indulgence and affluence, if he smooths the path of hard duty with a little mental excursion, instead of mere unprofitable recreation or dilipation, whatever may be his situation in life. Many a cow has been sold in consequence of evil propenities; few have been sacrificed to procure food for the mind. — Brown Prodr. Nov. Holl. v. 1. 490. Clas and order, *Pentandra Monogynia*. Nat. Ord. Convolvul., Juff. *Convolvulaceae*, Brown.

Eff. Ch. Calyx pitcher-shaped, five-sided, many-toothed. Corolla funnel-shaped, of one petal; imbricated in the bud. Gernn with two seeds. Style clawn. Stigmas capitate. Capule...

1. *W. humilis*. Humble Wilsonia. Br. n. 1.—Disco- vered by Mr. Brown, in the fourth part of New Holland. A little, dwarf, shrubby, prostrate, much branched, downy plant. Leaves small, sessile, thickish, imbricated in two ranks. Flowers axillary, solitary, sessile, without bracteas. Mr. Brown remarks, that the natural affinity of this genus must be uncertain while its fruit continues unknown. He met with the plant after the flowers were faded, before the seed-coffle was formed, nor is he certain whether the germen consisted of one cell, or of two. He ranges Wilfonia next after *Cepha*, of whose place in the natural system Linnaeus had formed no opinion, but which Juffien well refers to *Convolvul.,* notwithstanding the solitary seed.


**Wilsger**, a town of the duchy of Holstein, on the river of the same name; 8 miles N. of Glückstadt.

**Wilsum**, a town of Germany, in the county of Berchtes; 11 miles W.N.W. of Nienhaus.

**Wiltzer**, a town of the Tyrol, on the Inn; 3 miles above Innsbruck.

**Wilton**, an ancient market, borough, and county-town of Wilshire, England, derives its name from the river on which it was originally built. By old writers, it was called Wile, or Wily-Vilodanum and Ellandanum; and according to Baxter it was a chief seat of the British prince, Carvilius, and thence denominated Caer-Guilou. Henry of Huntingdon says, it afterwards became the capital of the West-Saxon dominions; but Leland and Dr. Milner con-
Wilton, a town of the district of Maine, in the county of Kennebec, containing 770 inhabitants; 60 miles N.N.E. of Portland.—Also, a town of New Hampshire, in Hillsborough county, with 1017 inhabitants; 30 miles E. of Cheltefield.—Also, a town of Connecticut, in the county of New London.
of Fairfield, with 1728 inhabitants.—Also a town of South Carolina; 27 miles S.W. of Charleston.

WILTOWN, a town of South Carolina; 21 miles W.S.W. of Dorchester.

WILTPERG, a town of Austria; 8 miles S.W. of Freystadt.

WILTSHIRE, an inland county, situated towards the south-western division of England, derives its name from the town of Wilton, which, according to some ancient historians, was the metropolis of the Anglo-Saxon kingdom of Wessex. On the north and north-west it is bounded by Gloucestershire, on the south-west by Dorsetshire, on the south and east by Hampshire, and on the north-east by the county of Berks. These boundaries are in general artificial, and form a figure approaching that of an ellipse. Concerning the extent and superficial area of this county, various are the statements of different writers. In the Magna Britannia it is said to be thirty-nine miles in length from north to south, and thirty in breadth from east to west. Gough, in his additions to Camden's Britannia, estimates its length at forty-one miles, and its breadth at thirty-four. Its circumference, according to the same author, is one hundred and fifty miles, and the number of acres it contains 876,000. Mr. Davis, whose authority on this subject is highly respectable, in his Agricultural Report on the County states it to be in length forty-five miles, and in breadth thirty-four. The same writer computes the superficial area to be 1372 square miles, or 878,000 acres.

The county of Wilts is a district peculiarly interesting to the topographer and antiquary. To the latter, indeed, it offers a wider and more varied field for research than perhaps any other county in England. The grand and mysterious monuments of Stonehenge and Avebury, and the numerous barrows which cover its plains, are relics of an age anterior to historical record, and of which the annals of the world do not furnish a parallel example. Like the proud pyramids of Egypt, the former were calculated by their construction to have remained entire to almost endless futurity, if the agency of the elements had not been affliated by the destructive influence of man. In the Wantdyke, Bokerly-ditch, and Grimshilly, and in the simpler intrenchments with which the county abounds, we behold the remains of British towns, and perceive the mode adopted by the Britons to mark boundaries and for communication. The cattles of Old Sarum, Scratchbury, Battlesbury, and Bratton, display the efforts of a more advanced period; and many other of the Wiltsire intrenched works bear marks of successive occupation by the Romans, the romanized Britons, the Saxons, and the Danes. This part of the kingdom, indeed, seems to have been the principal theatre of the military and civil events which were consequent on the Saxon and Danish invasions. Here the far-famed Arthur and the still more illustrious Alfred contended at different periods for the liberties of their country, and checked for a time the tide of invading conquest. At Ludgerhall, Devizes, Malmsbury, and Marlborough, the vestiges of Norman fortresses may yet be traced; and in Clarendon-park flood a magnificent palace, erected by king John. Malmsbury yet preserves the ruins of a magnificent abbey; and in the cathedral of Salisbury, we behold an edifice surpassing every familiar ancient structure in uniformity of style and symmetry of parts. Many of the parochial churches in the county are objects worthy the examination of the antiquary, as specimens of architectural skill and science; and in Wilton-house, Longford-castle, Font-hill, Corsham-house, Bowood, Tottenham-park, Charlton-park, Stourhead, and Longleat, we are presented with monuws ake celebrated for magnificence and beauty of scenery, and for popular attractions to the connoisseurs and artists of the country.

At the period of the invasion of our island by Julius Cæsar, a people called the Belgæ inhabited a portion of this county. The Hedui are said to have occupied its north-western division, near the source of the Avon and near Cricklade. Another district is mentioned by Carte, in his History of England, as being subsequently poftelled by the Carvili, so named from their prince Carvilius; but whether these people were some of the Belgæ, or a distinct tribe, does not appear. Other authors suppose that the Cangi inhabited the northern parts, if not at this era, at least soon after it.

When the Romans, after the lapse of nearly a century, from the final departure of Cæsar, again invaded Britain in the reign of Claudius (A.D. 44.), they found the political condition and relations of its several tribes very materially altered. The opinion of Camden, in his Britannia, is, that the Belgæ had subdued the whole of Wiltsire, and also had poftelled themselves of all the territories of the Hedui.

It is very generally admitted, that the Belgæ were the most powerful people in the south-western division of England at the era of which we are now speaking; and no doubt is entertained of their having occupied all the southern district of this county, as far as the Wantdyke, which is therefore designated by the appellation of 'The Great Belgic Boundary.'

Under the Romans, Wiltsire formed part of Britannia-Prima, and many stations, encampments, and other military vestigia of that people can be traced in different parts of it.

Subsequent to the departure of the Romans, the earliest event of political importance which occurs in history relating to Wiltsire is the massacre of three hundred British nobles, on the spot where Stonehenge is situated, by the orders of Hengist (leader of the first Saxon expedition to England), who had invited them here to a banquet under the pretence of effecting a reconciliation between the Britons and himself. The truth of this dreadful catastrophe, however, is extremely doubtful, as it does not appear to be mentioned by any of the Saxons writers, and seems to rest solely upon the authority of Nennius, and a few of the British or Welsh bards, who were evidently interested in the propagation of stories calculated to excite feelings of enmity and revenge in the breasts of their countrymen, against a people, once their allies, but afterwards their inveterate and barbarous enemies. Carte says, that this story was borrowed from Witukind, who relates it of the Thuringians, who were murdered by the Saxons on a like occasion, and upon a signal given in the same words made use of by the British writers. Turner, in his History of the Anglo-Saxons, regards it as an incident which can neither be authenticated nor disproved; and Whitaker, in his History of Manchester, afferts, that the conquests of Hengist never extended beyond the limits of Kent; a circumstance which, if fully established, would give no doubt tend to invalidate our belief of the transaction. Hume, in his History of England, calls it a story inverted by the Welsh authors, in order to palliate the weak resistance made at first by their countrymen, and to account for the rapid progress and licentious devastations of the Saxons. About the year 520, Cerdic, founder of Wessex, having received considerable reinforcements from Saxony, and cut off a body of Britons which had been dispatched to intercept them, collected all his disposable forces, and advanced to Mount Badon, Badbury-castle, a British post then
then considered of great strength and importance, on account of its commanding situation, and its proximity to the confluence of the Roman roads, which intersect the northeastern division of this county. The distinguished Arthur, who so long upheld the falling fortunes of his country, relieved the garrison with a large army formed under his own inspection: Cerdic, apprized of his intention, abandoned the siege, and waited the approach of the enemy. The conflict was severe: the genius of Arthur, however, ultimately prevailed over the superior science of the Saxon general, and the more steady conduct of his veteran troops. The subjugation of Wiltshire was not again attempted till the year 952, when warfare was once more renewed. Kenric, the son of Cerdic, and his successor in the Wilt-Saxon monarchy, again faced the frontiers of his dominions, and threatened the fortified towns of Old Sarum.

The British army took a position to secure its safety, and fought with their usual intrepidity, but were defeated by the superior discipline of the Saxons. At "Barbury Castle," near Marlborough, another decisive battle was fought, in which the invaders were again the conquerors; and Wiltshire in consequence became incorporated in the kingdom of Wessex.

After several skirmishes, a decisive battle was fought at Woodbury, in which the usurper of Wessex was defeated. The Danes made a descent on the island in the thirty-second year of Egbert's reign, and effectually ravaged Wiltshire. King Alfred afterwards attacked the Danes near Wilton, and routed them; but elated by successes, he incalculably suffered them to rally when they gained a victory.

Alfred engaged them in several battles with varied success, and ultimately compelled them to sue for peace, which was granted; yet in the following year, regardless of their recent engagements, they suddenly advanced to Chippenham, then a royal residence, and established themselves in that town. They had gained such considerable reinforcements, that the king, with a part of his army, retired into Somersetshire. Here he remained several months, occasionally falling out upon the enemy, destroying their magazines, and carrying off their provisions. Having mustered a considerable army, Alfred quitted his retirement, and advanced to Athelney, where the Danish forces lay encamped, attacked them by surprise, and gained a complete victory. No other particular event occurred in Wiltshire until 976, when a fyndow was held at Calne, in which the respective rights of the regular and secular clergy underwent solemn discussion: the secular clergy would not relinquish their pretensions; another council was, therefore, convened the same year at Amesbury, in which it appears the canons were unsuccessful.

The next historical occurrence in Wiltshire happened in 1009, when the towns of Wilton and Sarum were plundered and nearly burned to the ground by the Danish monarch.

In 1006 another army of Danes visited Wiltshire, and retreating to the coast through Wiltshire, when some of its natives attacked it in the vicinity of Kennet; the Saxons were, however, defeated, and purchased peace by submitting to the tribute called Danegeld.

England now remained tranquil five years, when in 1014 King Swein and his son Canute again landed on the south coast, and entering this county, levied heavy contributions on the inhabitants. King Edward at this time being indisposed at Corsham, his son Edmund took the field, and put the invaders to flight. An obstinate battle was fought, about this time, at "Sceatland," or Sheridon, on the northwestern verge of the county, by Edmund (who had just succeeded his father, Edward) against the Danes; the decision of the battle turned in favour of King Edmund by the unexpected flight of Canute. Subsequent to the Norman Conquest, Wiltshire retained a considerable share of political interest.

In the year 1086, the conqueror held a great council at Sarum; "where," says Blackstone, "all the principal landholders submitted their lands to the yoke of military tenure, became the king's vassals, and did homage and fealty to his person." Thus was the feudal system formally introduced into this country.

Clarendon, in this county, is remarkable for the laws passed there in the reign of Henry II.; "whereby," says Blackstone, "the king checked the power of the pope and the clergy, and greatly narrowed the total exemption they claimed from the secular jurisdiction," thus "the completion of his wishes was prevented by the murder of the proud and arrogant prelate, archbishop Becket. These laws are still familiar to the antiquary, by the appellation of the 'Constitutions of Clarendon.' At Marlborough, in 1207, Henry III. held a parliament, or a general assembly of the 'Estatists of England,' to provide for "the better state of the realm, and the more speedy administration of justice," and here were conterminously enacted those statutes for the suppression of tumults, which have ever since been denounced, 'The Statutes of Marlbridge.' In the contests between the houses of York and Lancaster, the inhabitants of Wiltshire were conspicuous for their attachment to the fortunes of the Henries. Many of them were present at the battle of Tewkesbury, an event which tended to fix the crown on the brows of Edward.

In the deplorable events of the 17th century, this county was equally distinguished. Many actions between the parliamentary and royal forces were decided within its boundaries; particularly at Malmesbury, at Ludgerhall, and at Round-a-way-hill, in the neighbourhood of Devizes. Wadbour and Longford castles were alternately besieged and taken by both parties within one year.

The returns of antiquity in Wiltshire, first entitled to notice in a collective view, are the stupendous monuments at Avebury and Stonehenge, both of which are regarded as druidical temples. In these structures we are prescient of the most wonderful works of a rude but powerful people; works in which the bodily strength of associated numbers, with the science and cunning of their age, are strongly manifested, and which are calculated not only to excite the transported gaze and amazement of the multitude, but also to rouse curiosity and awaken inquiry in the minds of antiquaries and historians. See Avebury, and Stonehenge.

Next to these immense temples, because resembling them in relative magnitude, though totally dissimilar in kind, the Wansdyke may properly claim attention. This vast earthwork, which is supposed to have originally intersected the whole country, is now only distinctly visible in detached places, throughout the range of hills to the south and west of Marlborough, where it still remains tolerably entire, and in one place is seen in a bold and connected line for the space of ten or twelve miles.

**Barrows, or Tumuli.—** Of corresponding antiquity to the monuments already named, are the artificial hillocks or mounds of earth which abound in this county, and which appear to have an intimate connection with these temples, as they are more numerous around Stonehenge and Avebury than in any other places. These memorials were undoubtedly appropriated to sepulchral purposes. By the researches of Mr. Cunnington, Sir Richard C. Hoare's 'Ancient Wiltshire,' the Rev. James Douglas's 'Nennius Britanniae,' and a few other enlightened antiquaries, we are made
made familiar with the contents of these sacred depositories. See Barrow, and Tumuli.

The Roman stations mentioned in the Itinerary of Antoninus, as being situated within the county, are three in number, Sorbiodunum, Verulamium, and Cunetio. The first of these is placed by all antiquaries at Old Sarum; but the situation of the other two has been much disputed. Camden fixes Verulamium at Welbed; Horley, at Lackham; and Stukeley, whose opinion is the most probable, in the neighbourhood of Heddington. Cunetio was formerly supposed by some writers to be at the village of Kennet, and by others at the present town of Marlborough; but it is now generally allowed to have been situated at a short distance east of the latter place, near the north-eastern boundary of Savernake forest. Besides these, the Romans had several other settlements in this county; particularly at Eallon-Grey, at Wanborough, at Pitmed at Heytesbury, and at Littlecote, at each of which places tessellated pavements and other Roman remains have been found. Of the Roman roads which passed through Wiltshire, the principal was a continuation of the Julia Strata, which entering the county from Bath, left it near Hungerford on the east. The Fosse road branched off from the Julia Strata at Bathford, at the north-west corner of the county, where in many places it is still conspicuous. Several other roads connected Sorbiodunum with neighbouring stations; and of these, three are traced with considerable certainty: first, one which led to Durnovaria, or Dorchester; secondly, that to Venta-Belgarum, Winchester; and thirdly, another to Vindonissa, or Silchester.

The numerous encampments and other intrenched earthen works with which Wiltshire abounds vary not only in size and shape, but in method of construction and peculiarity of situation. Some of these are doublets the works of the Britons, others of the Belgae, of the Romans, of the Saxons, the Danes, and the Normans. Many of them, however, have been in all probability successively occupied and altered by the armies of one or more of these nations, at different periods subsequent to their original formation. The immense fortifications of Old Sarum, Chidbury-hill, near Warmington, and Vephanian's camp, near Amesbury, constitute the most distinguished monuments in these classes of antiquities.

Castles.—That this county, at an early period, contained a number of those baronial fortified structures, which are usually designated by the term castles, and which are supposed by several writers to have been first introduced by the Normans, is undoubtedly. Most of them, however, are now totally demolished, so that it is even difficult to ascertain their actual sites; and the rest have been so much altered in later times, as almost to efface every vestige of the original building. The more celebrated of these edifices, and those which most frequently occur in the ancient historians, are the castles of Marlborough, Devizes, Lodergham, Wardour, Combe, and Malmbury.

General Aspects.—In a geographical arrangement, Wiltshire may be said to be naturally divided into two portions, by an irregular range of hills, which extends transversely through the greater part of the county in a direction inclining from the north-east to the south-west. These districts are usually denominated South and North Wiltshire, and differ very materially from each other, not only in appearance, but in almost every distinguishing quality.

South Wiltshire, which claims priority of notice on account of its superior extent, forms the western division of a vall tract of chalk-hills, which extends into Hampshire, and having for its boundaries the rich lands of Berkshire, and the extreme verge of the Marlborough hills on the north; the broken ground of Somerfetshire on the west; the new forest of Hampshire on the south; and the heaths of Surrey and Suffolk, together with the Weft Downs of the latter county, on the east. The surface of the higher down, to use the words of Gilpin, is "spread out like the ocean, but it is like the ocean after a storm; it is continually heaving in large swells." In some parts, the hills assume the form of round knolls, and are separated by smoothly-fided hollows, which vary considerably both in depth and extent. At other places they range along for a short distance in connected ridges, flowing on one side of the range rather a rapid declivity, from the top of which, on the other side, the hills sink in irregular gradation, till at length they frequently delve into a perfect flat. This effect, says Marshall in his "Observations on," what he terms the "Western District" of chalk hills, is of course more particularly distinguishable, "where the range of hills is narrow, single, than where a congeries of such ranges are crowded together disorderly." The whole of this district, generally speaking, is separated into two divisions, the one called Marlborough-Downs, and the other Salisbury-Downs or Plain.

The principal valleys in this division of the county lie along the banks of the rivers, the most remarkable of which diverge like irregular radii from the country around Salisbury and Wilton. These display rich meadow and corn lands, intermixed with fields and villages, and finely covered in various parts with plantations of wood.

North Wiltshire differs entirely from the southern division of the county in its general appearance. Instead of a constant series of "chalky waves," the aspect of this district, which extends from the verge of the Downs to the hills of Gloucestershire, is nearly that of a perfect flat; the few deviations from the ordinary level being so gradual as scarcely to be perceptible, on a cursory view. The country here is so close and well wooded, that when viewed from any of the surrounding hills, it appears like one vast plantation of trees. If examined in detail, however, it is found also to contain many extensive tracts of rich pature land, situated on the banks of the Lower Avon and the Thames, and of smaller streams which flow into both of those rivers.

Rivers.—Wiltshire abounds with rivers, which either take their rise within the county, or on its immediate confines. Two of these, the Thames and the Lower Avon, are unquestionably important streams. All the others are much inferior both in extent and confluence; but several of them deserve to be particularly noticed, viz. the Upper or Salisbury Avon, the Nadder, the Willey, the Bourne, and the Kennet. See Thames.

The Lower Avon rises in the hilly district of North Wiltshire, at a short distance from the town of Wootton-Bridge.

The Upper Avon is formed by the confluence of several smaller streams, which take their rise among the hills near the centre of the county. The Kennet rises near Avebury, and running in an easterly direction, unites with the Thames at Reading. The Willey and the Nadder join their streams at Wilton, and unite with the Avon at Salisbury.

The chief of North Wiltshire has long been devotedly celebrated; though for some time after it became the staple commodity here, it was sold in the London market as the manufacture of Gloucestershire. See Cheese.

Waste Lands.—It is a common idea that the Wiltshire downs consist entirely of "waste land." This notion, however, is completely erroneous; for if the correct appropriation of land is to be estimated by its comparative utility in
WILTSHIRE.

in different conditions, the application of the grounds in the chalk district cannot be very easily improved, or materially altered for the better.

In North Wiltshire the number of common fields is very great, but none of them are of any considerable extent. It is subject of regret, however, that they should exist at all, as many of them are deserted over the richest foil in the district; and if brought under regular cultivation would be extremely productive.

The chaises within Wiltshire are suppos'd to have been numerous formerly, but only three woodland districts now retain that peculiar appellation: these are Cranbourne-chen, Vernditch-chen, and Aloubn-chen. The first and second join each other, and occupy a long narrow track of country on the southern confines of Wiltshire. There are three canals which intersect parts of this county: first, the Thames and Severn; secondly, the Kennet and Avon; and thirdly, the Wiltshire and Berkshire. See CANALS.

The manufacturies of Wiltshire are various, and of great extent. Salisbury is noted for its flannel and fancy woollen; and besides carries on a considerable manufactory of cutlery and steel goods, which are probably superior in workmanship to any in the kingdom. Wilton was celebrated for a large manufactory of carpets, and Mere for another of fancy woollens; and in its neighbourhood a great quantity of linen is made, chiefly dawlas and bed-ticks. Broad cloths, kerseymeres, and fancy cloths, are the principal produce of the towns of Bradford, Towbridge, Warminster, Weftbury, Melksham, Chippenham, and all the adjacent towns and villages from Chippenham to Heytesbury. At Albourn is an excellent manufactory of cotton goods, of which fustians and thickets form the most valuable portion. Swindon and its vicinity has been long famed for its manufactory of gloves.

Ecclesiastical and Civil Division and Government.—The whole of this county is situated in the province of Canterbury; and, with exception of the parish of Kingwood, is in the dioceze of Salisbury. It comprehends two archdeaconries, Sarum and Wilts; the former comprising the deaneries of Salisbury, Amesbury, Chalk, Potter, Wilton, and Willy; and the latter, with the annexed rectory of Minety, thofe of Avebury, Cricklade, Malmbury, and Marlborough.

As in the other counties of England, the chief civil magistrates of Wiltshire are, the lord lieutenant, the mayor of Salisbury, and the mayor of each of the following boroughs; Chippenham, Calne, Cricklade, Devizes, Heytesbury, Hindon, Downton, Great Bedwin, Marlborough, Malmbury, Ludgerhall, Wiltbury, Wilton, Wootton-Baffet, and Old Sarum. At an early period the whole county was divided into twenty-nine districts, called hundreds; and these again subdivided into two hundred and ninety-five smaller districts, called parishes; with parts of fourteen others. In the county is one city, Salisbury; and twenty-three market-towns, viz. Amesbury, Bradford, Calne, Chippenham, Cricklade, Devizes, Downton, Great Bedwin, Heytesbury, Hindon, Ludgerhall, Melksham, Marlborough, Market-Lavington, Swindon, Towbridge, Warminster, Wiltbury, Wilton, and Wootton-Baffet.

The government, provincial management, number, and rate of the poor in this county, as laid before parliament in the year 1803, and published by authority of the House of Commons, are detailed in the following particulars. It is stated, "that returns were received from three hundred and thirty-six parishes, or places, in the county of Wilts, in the year 1803; in 1785, the returns were from three hundred and thirty-six; and from three hundred and twenty-five, in 1776." It is then further stated, "that forty-one parishes, or places, maintain all or part of their poor in workhouses; the number of persons so maintained, during the year ending Easter 1803, was one thousand six hundred and seven; and the expense incurred therein amounted to 14,547l. 2s. 0d., being at the rate of 8l. 19s. 8d. for each person maintained in that manner. By the returns of 1776, there were forty workhouses capable of accommodating two thousand and seventy-nine persons. The number of persons relieved out of workhouses was forty thousand five hundred and eleven, besides four thousand five hundred and thirty-six, who were not parishioners. The expense incurred in the relief of the poor, not in workhouses, amounted to 113,888l. 17s. 9d." A large proportion of those who were not parishioners appear to have been vagrants; and, therefore, it is probable the relief given to this class could not exceed 2s. each, amounting to 453l. 12s. od. This sum being deducted from the above 113,888l. 17s. 9d., leaves 113,435l. 5s. 9d., being at the rate of 3l. 6s. 8d. for each parishioner relieved out of any workhouse. The number of persons relieved in and out of workhouses was forty-two thousand one hundred and twenty-eight, besides those who were not parishioners. Excluding the expense suppos'd to be incurred in the relief of this class of poor, all other expenses relative to the maintenance of the poor amounted to 131,864l. 19s. 9d., being at the rate of 3l. 2s. 7d. for each parishioner relieved. The resident population of the county of Wilts, in the year 1801, appears from the population abstract to have been one hundred eighty-five thousand one hundred and seven; so that the number of parishioners relieved from the poor's rate appears to be twenty-three in a hundred of the resident population. The number of persons belonging to Friendly Societies appears to be fixed in a hundred of the resident population. The amount of the whole total money raised by rates is 16s. 0d. per head on the population. The amount of the whole expenditure on account of the poor appears to average at 14s. 7d. per head on the population. The expenditure in suits of law, removal of paupers, and expenses of overseers, and other officers, according to the present abstract, amounts to 962l. 15s. od. The amount of such expenditure, according to the returns of 1785, was then 250l. 13s. 4d. The expenditure in purchasing materials for employing the poor, according to the present abstract, amounts to 849l. 8s. 7d. The amount of such expenditure, according to the returns of 1785, was 434l. 11s. 9d. It does not appear from the returns received, that the poor of any parish or place in this county are farmed or maintained under contract. The poor of six parishes are maintained and employed under the regulations of special acts of parliament. Thirty-six Friendly Societies have been enrolled at the quarter-seessions of this county, pursuant to the act of 33 & 35 Geo. III.—Beauties of England and Wales, Wiltshire, by J. Britton, F.S.A. 8vo. 1814. Ancient Wiltshire, by Sir Richard C. Hoare, bart., folio, 1815.
Wiltshire of Eleven-shafted PloUGH, in Agriculture, an
implement of this kind invented and used in that district.
In Oxfordshire it is employed for many different purposes ;
as for cleaning the land, and with shaves contrived for fur-
rowing the land previous to sowing. The crops principally
own, or put in after the use of this implement, are those of
tamed wheat and turnips. See PLOUGH.
WILIZ, in Geography, a town of France, in the depart-
ment of the Forets; 6 miles N.W. of Diezicr.
WILZBURG, a fort of Germany, in the principality of
Anspach; 2 miles S.E. of Anspach.
WIMACK, a town of New York, in Long
Island; 44 miles E. of New York.
WIMBA, or WINIPA, a town of Africa, on the Gold
Coast; 20 miles S.W. of Accra.
WIMBLE, in Rural Economy, a term provincially made
use of to signify a boring auger. See AUGER.
WIBDON, in Geography, a village of England, in the
county of Surrey; supported by Camden and others to be
the place where Ethelbert king of Kent was defeated by
Cæolin king of the West Saxons. According to histroy,
the battle was fought in the year 586, at Wibdone. At
the south-west corner of Wimborne common is a circular
encampment, with a single ditch, containing a space of about
seven acres; 9 miles S. of London.
WIMBORN or WINEBORN Minster, a market-town
of remote antiquity, in the hundred of Badbury, Shafton
division of the county of Dorset, England, is situated on the
river Allen, near its confluence with the Stour, at the distance of 28 miles E.N.E. from Dorchester, and 100 miles S.W.
by W. from London. It was called by the Romans Vindol-
gladus, alluding to its situation on a river. The appellation of Wimborne is Saxon, derived from Bourne, a vale, and
Wim, a small river which flows near the town. The term
Minster, from the church, was added to distinguish it from
other places of the same name. Camden states this town to have been a place of great confluence in the Saxon times,
and that it then retained many marks of Roman grandeur.
The present appearance indicates no vestiges of its former
prosperity, though large and populous, it has little to re-
commence it to notice; the streets being irregular, and the
houses deficient in uniformity. The trade carried on is
chiefly confined to the woollen manufactury and the knitting
of hosiery. The great object whence Wimborne derived its
ancient reputation, and to which it is solely indebted for its
modern celebrity, is the Nunnery, which was founded
among the earliest of its kind in the kingdom. It was
erected, as Leland informs us, in the beginning of the eight
century, by St. Cuthburga, daughter of Kenred, and
sister of Ina, king of the West Saxons. In the reign of Ed-
ward the Confessor, or of one of the Edwards his predece-
sors, this edifice being destroyed by the Danes, the
establishment was dissolved, and converted into a college of
several canons, consisting of a dean, four prebendaries, three
vicars, and other inferior officers. This college subsisted till
the year 1547: on the dissolution the revenues were vested
in the crown. Great part of the lands was granted to
Edward, duke of Somerset; and part was by queen Elizabeth
vested in the corporation of the college towards the founda-
tion of a grammar-school. In the reign of Charles I., all
the possessions of the church and school were granted, in
trust, to twelve governors, who, among other conditions,
were to find for the service of the collegiate church three
priests, three clerks, and subordinate members. This esta-
blishment, with some temporary obstructions, has been kept
up ever since. The revenues at present amount to between
three and four hundred pounds. The church merits parti-
cular notice for its age and venerable appearance, and for
the peculiarities of its architecture. Mr. Gilpin says, its
form dates its antiquity, being of the heaviest and earliest
Saxon style. Dr. Stukeley, however, and other antiquaries,
were of opinion, that the eastern tower, and most part of
the church, were built soon after the Conquest. Many
parts are of early Norman architecture, particularly the
femicircular arches in the eastern tower, the sable windows
in the south transept, and several others. The church is
cruciform, with two quadrangular towers, one standing
on the middle of the roof, and the other at the west end; the
former was anciently ornamented with a spire, said to be of
an extraordinary height. The whole edifice consists of a
chancel, nave, choir, and side aisles, a transept, and three
porches. Its length, from east to west, is 180 feet. Both
chancel and choir are supported by eight pillars, over which
are five windows on the north and three on the south side.
The nave is supported on each side by six massive pillars of
an irregular form, above which are pointed arches, with zig-
zag mouldings: the whole enlightened by a similar number
of windows, apparently of a more modern style. Many
royal and noble persons have been interred in this church,
most of whom were anciently commemorated by suitable
monuments. Of these time has destroyed many, and the
hand of violence more. Among those remaining, the most
conspicuous is that of king Ethelred, who, as the inscription
states, was slain by the Danes April 23, 872. This tomb
stands in the choir on the north side of the altar. On the
opposite side is that of the duke and duchess of Somerset
(parents of Margaret, countess of Richmond, mother of
Henry VIII.), with their effigies in alabaster. Within this
church were once standing ten altars for the celebration of
divine service, all of which were composed of alabaster and
other costly materials, and suitably ornamented. The fur-
ture of the high altar was particularly splendid; consisting of
a variety of croffes and images, and other objects of
worship, of silver-gilt, and adorned with precious stones.
Exclusive of the church, the public buildings of Wim-
borne are few and uninteresting. The town-hall was suf-
ered to fall to decay; near its site is an open space, called
the Square. Here are two meeting-houses for Presbyterian
ians and Anabaptists; and large commodious workhouses.
Two annual fairs are held, and a weekly market on Fridays.
The north part of the town has been long styled a borough,
and consists of two streets, East Borough and West Borough.
It was never incorporated, but is governed by two
bailiffs annually chosen. The south part of the town, in-
cluding all that is not in the borough, comprises the tything
of Wimborne Minster. The population of the whole, by
the return of the year 1811, was enumerated at 3,158; the
houses at 791. About a quarter of a mile from the town
is an hospital, or almshouse, with a chapel adjoining,
called St. Margaret's hospital. The time of its foundation
is entirely unknown; but by several curious deeds preserved
in the chapel, it appears to be at least as old as the time of
king John, when it was set apart for the relief and support
of poor persons afflicted with the leprosy. "It does not ap-
ppear to have had any endowment, but to have been sup-
ported by voluntary donations, for which pope Innocent IV.,
in the year 1245, granted special indulgences. Since the
year 1688, the alms-people are not required to have the
original qualification of leprosy, but only to be poor aged
people. A second hospital, or almshouse, was founded and
endowed by Gertrude Courtney, marchioness of Exeter, for
the maintenance of six poor men and women; and a patent
was
WIN.

was procured from queen Elizabeth for incorporating the "governor and poor persons:" they were invested with a common seal and other corporate privileges. But notwithstanding this parade, the charity has dwindled to nearly nothing; the fix persons now on the foundation having only each a room, and the poor pittance of fifty-two shillings yearly.—Hutchins's History of Dorsetshire. Beauties of England and Wales, vol. iv. Dorsetshire. By J. Britton and E. W. Brayley.

WIMBREL, in Ornithology, the English name of a bird of the curlew kind, the 

*Scolopax phasianus* Linnaeus, and known among authors by the name of *arguta minor*, or the lesser curlew, and called in the Venetian markets *taraniola*.

It is much of the shape of the common curlew, but is not more than half its size. Its beak is about three fingers' breadth long, dusky above and red below; its feet are greenish; the feathers on the head and neck brown tinged with red, marked in the middle with an oblong black spot; the upper part of the back, coverts of the wings, scapulars, and farthest quill-feathers, of the same colour with the neck, but the black spots spread out transversely on each web; the quill-feathers dusky, their shafts white, and their exterior webs marked with large semicircular white spots; the breast, belly, and lower part of the back, are white; the coverts of the tail are of a pale whitish-brown, crossed with black bars. Its haunts and food are much the same with those of the curlew, but it is much less frequent on our shores. Pennant.

WIMES, in Geography, a town of France, in the department of the Straits of Calais; 9 miles S.S.W. of St. Omer.

WIMMERBY, a town of Sweden, in the province of Smaland; 62 miles N. of Calmar.

WIMMIS, a town of Switzerland, in the canton of Berne, on the Sihun; 18 miles S. of Berne.

WIMPPEL, of the Dutch *wimpel*, a muffer, a plaited linen cloth, which nuns wear to cover their necks and breasts.

The word is also sometimes used for a streamer, or flag.

WIMPFEN, in Geography, a town of Germany, on the Neckar, near which it is joined by the Jaxt. This place consists properly of two towns, the most considerable of which is called Wimpfen-sulz-demburg, or Wimpfen on the hill; and the other Wimpfen-in-thal, or Wimpfen in the vale. In the former of these are a Lutheran parish-church and a grammar-school, as also a Roman Catholic hospital; but in the latter is a Roman Catholic abbey, with a convent of monks. The magistrats here are wholly Lutherans. The Huns are said to have ravaged this town; but an instrument of donation by king Henry VII. bearing date in the year 1288, shews it to have entirely recovered from that calamity. On the failure of the dukedom of Swabia, it gradually procured its freedom, and the emperors Charles IV. and Wenceslaus promised to maintain it in its immediate dependency on the empire. In the years 1645 and 1688, it was taken by the French. In 1802, it was given to the duchy of Baden; 8 miles N. of Heilbronn. N. lat. 49° 15'. E. long. 9° 15'.

WIN, at the beginning or end of the names of places, signifies that some great battle was fought, or a victory gained there. The word is formed from the Saxon *winnan*, to win, or overcome.

WINANDER MERE, or Winder Mere, in Geography, a lake of England, in the county of Westmoreland, in which is an island, with a village. This is one of the largest lakes in England, being 15 miles long, and two broad, and from 90 to 200 feet deep, well furnished with fish of several sorts, but especially char; 17 miles S.S.E. of Keswick, and 270 N.N.W. of London.

WINBERG. See Winterberg.

WINCANTON, or Wincanton, a market-town in the hundred of Norton-Ferris, and county of Somerset, England, is situated on the western slope of a hill near the river Cale, at the distance of 108 miles W. by S. from London. It is a place of remote antiquity; and was probably occupied by the Romans, as numerous coins of that people were discovered here in the early part of the last century. The Saxons were long in possession of it; and it is recorded in Domesday-Book to have been held by one Elf in the reign of Edward the Confessor; but when William came to the throne he gave it to Walter de Doucer. It afterwards passed to the Lovells, lords of Castle Cary, and through the families of St. Maur and Zouch, till by attainder it was given to the crown, 1 Henry VII., who granted it to Giles, lord Daubery. The town, in its present state, consists of four principal streets. A fire which occurred in 1747 opened a way towards the improvement of the buildings. The turnpike-road from Taunton to Salisbury runs through it. A considerable market is held on Wednesdays for cheese, butter, pigs, and flax-yarn for the linen manufactures, which are chiefly thofe of dowlas and ticking, in which most of the poorer inhabitants find employment. Here are also three annual fairs. The town-hall is a respectable brick building, with a rustic stone basement: here is likewise a small old market-house, with a few stalls. At the west end of the town, in the road to Castle Cary, is a stone bridge of two arches over the Cale: there is another of one arch over the same stream in the road to Bruton. Wincanton church is a spacious edifice, and consists of a nave, chancel, and two aisles. The church is ancient; but the chancel was rebuilt, and the church new-roofed and windowed in the year 1748. At the west end is a plain square tower. The parih extends nearly seven miles from north to south, and three miles from east to west: it includes, besides the town, five small hamlets. The population return of the year 1811 states the whole to contain 380 houses, and 1850 inhabitants. Within this parish, at the distance of about three miles north-east from the town, are the remains of the priory of Stavordale, founded in the reign of Henry III., by Richard Lovel, then lord of the manor, for canons of the order of St. Augustine. The priory is now converted into a farm-house and barn, in which several arches and other parts of the original structure still remain.—Collinson's History of Somersetshire, vol. iii. 4to. 1791.

WINCH, a popular term for a windlass.

WINCH also denotes the crooked handle for turning round wheels, grind-foones, &c.

WINCH, a small windlass, with an iron axis, hung in hodings or gudgeons, abaft some vessels' masts to hoist the main-fall, &c. with a conical piece of timber at each end without the checks. It is hove round by two iron handles, formed by cranks or winches, from whence it takes its name.

WINCHES, the large iron handles by which the main-pumps in ships are worked.

WINCH, used by rope-makers, is made of wood, having four spokes at each end, connected together by four blades, to form the body. Through the centre of the spokes is a hole to receive an iron bolt, on which it turns by a handle in one of the spokes. Its use is to wind the yarn on as it is spun.

WINCH, to twill or make spun-yarn with, is similar to the former, but much less. The motion given to this winch is by the hand in twilling the yarn: on the edges of the spokes is a small iron hook to flot the yarn in twilling, after

Vol. XXXVIII.
after which the spun-yarn is wound round the body of the winch.

WINCHCOMBE, in Geography, a market-town in the lower division of the hundred of Kilfrate, Gloucestershire, England, is situated on the Cotswold-hills, 15 miles N.E. by E. from the city of Gloucester, and 95 miles W.N.W. from London. It was anciently a town of considerable importance, was written Winclcumbe in Domesday-Book, and was there styled a borough when only Gloucester and Bristol, in the same county, were dignified with that title. It was the seat of a castle, and of a mitred abbey sufficiently capacious for the reception of 500 monks; but every vestige of these buildings has long been levelled with the dust, and the places where they stood are only conjectured. By whom the castle was erected is unknown; but the abbey was founded in 798, by Kenulph, king of Mercia, and was consecrated with great solemnity in the presence of three kings, and a great number of prelates and nobles. Being destroyed by the Danes, it was rebuilt in 981 by Olaf, bishop of Worcester, who converted it into a college of seculars, and restored it to great splendour. It was largely endowed; and in the reign of the Conqueror nineteen mansions in this county were annexed to it, independently of Winchcombe itself. In 1265 its abbots were dismissed to parliament, and the privilege was continued to all the succeeding abbots. The twenty-eighth abbott, Richard Ancelm, surrendered his abbey and its possessions to Henry VIII. in 1539. The edifice was soon after totally destroyed. Tradition reports it as very magnificent; but no description of it is now extant. Winchcombe, with a small territory adjoining, is said to have been, in the Anglo-Saxon time, a sherrifdom or county of itself; but in the reign of Canute, it was divested of its independence, and annexed to Gloucestershire. The town now consists chiefly of two streets, intersecting each other; the houses are low, and principally of stone. The difficulty of approaching it, through the badness of the roads, has prevented it from being much visited; but the new turnpike-roads have now opened a short and easy communication. The church is a spacious structure, with a nave, chancel, two aisles, and an embattled tower: the body of the church is also ornamented with battlements and pinnacles. The old church stood on the west end of the town; but having fallen to decay, the present fabric was begun in the reign of Henry VI. by the abbott, William Wincombe, who completed the east part: the remainder was finished by the parishioners, assisted by the munificence of Ralph Boteller, lord Sudeley. The government of the town, which is a borough by prescription, is vested in two bailiffs and ten aldermen from the latter, the bailiffs are annually chosen. A weekly market is held on Saturdays, and here are three annual fairs, which are well attended; but from the decline of the town very little trade is carried on, a papermill and a tan-yard being the chief sources of employ. The workhouse is an ancient irregular building, in which the poor are employed in spinning and weaving linen. Here are also an almshouse for twelve poor women, and three charity-schools. The population of the town in the year 1811, according to the return to parliament, was 1536, occupying 399 houses: the parish extends twelve miles in circumference, and includes nine hamlets; the enumeration of the whole was 56 houses, and 1536 inhabitants.

About a quarter of a mile to the south-east of the town are the ruins of Sudeley-castle, erected by Ralph, lord Bote- ller, an eminent state-man in the reign of Henry VI., on the site of a more ancient castle which appears to have been the residence of Harold, son to Radulf, earl of Hereford, in the time of the Norman conqueror. In this family, which assumed the name of Sudeley, the manor continued till the 41st of Edward III., when it was conveyed by marriage. Sudeley was attached to the crown till the reign of Edward VI. when it was granted to Sir Thomas Seymour, who settled there with Catharine Parr, the queen-dowager, whom he had married, and who died here in child-bed, not without suspicion of poison. Seymour being afterwards attained, Sudeley was granted to William Parr, marquis of Northampton, who forfeited it soon afterwards. It now belongs to the marquis of Buckingham. Of this once-famed fortress, very little remains: parts of the tower, the hall, and the chapel, serve to shew the style of architecture and character of the buildings. — See Williams’s History, &c. of Sudeley Castle, folio. Also Beauties of England and Wales, vol. v. by J. Britton and E.W. Brayley.

WINCHELSEA, a borough and market-town on the coast of Sussex, England, situated about 3 miles W. from Rye, 8 E. from Halling, and 67 from London. It is a member of the Cinque Ports, and an incorporated town, the officers of which consist, according to its charters, of a mayor and twelve jurats; but these are seldom composed of more than four or five persons. Winchelsea is a place of antiquity; but by the ravages of the sea, the sites of its houses, at different periods, have totally changed. The epoch of the rapid though gradual overthrow of the original town is fixed by Leland between 1280 and 1287. During that time the inhabitants petitioned Edward I. for ground to found another town, who accordingly granted them the site of the present town, which he surrounded with walls, and to it the inhabitants gradually removed. The new town afterwards fell into decay, from a cause just the reverse of that which ruined the old; for the sea deserted its neighbourhood, and left in its place a dreary marsh. This began to be feebly felt in the end of the reign of queen Elizabeth. The channel leading to the harbour was choked, the coast was deflected, and the town, abandoned by the trader, soon declined. The houses and churches fell to ruin, so that a town, once covering a surface two miles in circuit, is now reduced to comparatively a few houses in the centre of an ancient site, now a mile and a half from the sea. Of the ancient church, the lofty and spacious chancel, now used for divine service, and three aisles, alone remain entire. It is in two monuments, with effigies of knights templars. Some fragments of the walls and of three gates of the town still exist. From the situation of Winchelsea, and the spacious vaults frequently discovered, it is probable that the town was the principal mart for French wines, imported into England before the wine-trade with Portugal was established. Winchelsea sends two members to parliament, who are elected by about forty freemen. The houses in this parish, in 1811, were 126, containing 131 families, and 652 persons.—Beauties of England, vol. XIV. 1813.

WINCHELSEA, an island in the Pacific ocean; 30 miles S.E. of Sir Charles Hardy’s island.

WINCHENDON, a town of the state of Massachusetts, in the county of Worcester, with 1732 inhabitants; 56 miles N.W. of Boston.

WINCHESTER, an ancient and eminent city in Hampshire, or the county of Southampton, in England, 11 miles N.N.E. from Southampton, and 62½ W.S.W. from London. The buildings are disposed on the eastern declivity of a low hill, which gently slopes to the valley of the river Itchen, the chalky cliffs of which, and the chalky foil of the surrounding heights, in the opinion of Camden, occasioned the ancient name of the city, Caer-Gwent, signifying the ‘white city.’ The latter portion of the name,
under the Romans, became Venta, with the addition of Belgarum, from its situation in the country occupied by the Belgae, by which it was distinguished from Venta Silurum, now Caerwent, in Monmouthshire, and Venta Icenorum, now Caistor, near Norwich, in Norfolk. From Gowen or Venta we have the first part of the name, and chester, the last part, is a corruption of castrum, the Roman term for encampments of different kinds; a frequent name, or appellation of a name, of various places in England, and perhaps invariably an indication that such places owe both their origin and their primitive form to the military stations of the earliest conquerors of Britain.

Historic Events.—The origin of Winchester, remote as it unquestionably is, has been carried back to an epoch far beyond belief, even a century and half anterior to the foundation of Rome. Without referring to such remote and uncertain time, we may safely infer that this spot was occupied by the Belgæ, a Germanic tribe, who passing from Gaul, took possession of the country bordering the southern coast of England. (Cæsar's Bel. Gal. ii. 4.) Previous to their occupancy, it is conjectured that Winchester was the Caer-Gwent, or white city, of the aboriginal Britons. After the Romans had subdued the Belgæ and the Britons, they took possession of this town, and fortified it with ramparts and walls. These were disposed on the sloping side of a hill, and in the usual form of a parallelogram. Within this inclosure the town was constructed and arranged; and from the importance of this station, and its connection with other stations by military roads, there can be little doubt that Venta Belgarum, the Roman name, was a place of considerable importance. Among the antique relics of the Romans, which have been discovered at Winchester, are several coins, urns, &c.; also some fine coins of Caracallus, called the first British emperor. After the Romans left the island in 446, Gortheryn, or Vortigen, was elected chief of the western district, and he fixed his seat of government at Winchester. This town, as well as the whole island, was soon defined to experience a total change of polity, customs, and manners, by the introduction and domination of the Saxons in 519. On this occasion, the name of the city was changed from the Britih Caer-Gwent and the Roman Venta to another of equal import, Wintan-ceaster, from which the modern name, Winchester, has gradually been formed. In 635 an important event occurred in Winchester, the arrival there of Birinus, deputed by pope Honorius to preach the gospel in those parts of the country still involved in paganism. Favoured by king Cynegils, Birinus's apostolic labours were eminently successful: for the king founded a new cathedral on the site of that destroyed by Diocletian, which was consecrated under his son and successor, Kenewalch, in 648. Egbert, king of the West-Saxons, succeeding in the subjection of all the other Saxon princes, was in 827 crowned king of all England in the cathedral of Winchester, thus created or confidered to be the metropolis of the whole kingdom; and there, about 854, Egbert's successor, Ethelwulf, granted his famous charter, establishing a general synod of tythes. About this period the commerce of the city is recorded to have greatly increased, and the principal inhabitants are stated to have constituted a guild, under the royal protection; the earliest association of the kind, by a century, recorded in history. During the greater part of this and the succeeding reign, the see of Winchester was filled by the celebrated St. Withun, by whose advice king Ethelbald raised fortifications for the defence of the cathedral against the Danes. Landing at Southampton, they advanced to Winchester, where they committed horrible excesses; but the cathedral escaped their fury. About 871, however, that greatly suffered by them, and all the clergy belonging to it were massacred. On the ultimate success of the great Alfred, Winchester resumed a portion of its former splendour; it became again the seat of government; there the public records of the kingdom were deposited, in particular the general survey, called, from this circumstance, Codex Wintoniensis; afterwards imitated by William the Conqueror in 1086, in the famous Roll of Winchester, or Domesday-book. (See Domesday.) The succession of Edgar the Peaceful increased the importance of Winchester. Among the judicious laws which he established was one to prevent frauds arising from the diversity of measures used in the country, by providing a standard legal measure for the whole of his dominions. This was the origin of the established Winchester measures; the standard vessels for measurement made by Edgar's orders being deposited in that city, where the original bushel is still preserved. In the reign of this prince, in 980, the cathedral, having been partly rebuilt, was solemnly re-consecrated. About the same time the married canons of the cathedral were, at the suggestion of St. Dunstan, removed, to make room for Benedictine monks. In Winchester, in 1002, and in the reign of Ethelred, famous the Unready, commenced the general massacre of the Danes, in merciless vengeance for the atrocities they had committed on the inhabitants of the country. Thence arose the noted lock-tide sports, of which some traces may still be observed in remote corners of England. But this vengeance remained not long unrewarded by Swayne the Dane, who obtained possession of Winchester eleven years afterwards. St. Ethelph II., then bishop, is said to have first introduced organs into the cathedral. Canute, obtaining the sovereignty of England by the death of Edmund Ironside in 1016, chose Winchester for his capital, and, with other rich gifts, bestowed on the cathedral his crown, which was placed over the crucifix on the high altar: for Canute had vowed never more to wear that ensign of royalty, from the day when, by commanding in vain the flowing tide not to approach his feet, he proved to his flatterers the emptiness of their adulation, in hailing him lord of the ocean. Winchester cathedral is described to have been the scene of a legendary tale relating to queen Emma, mother of Edward the Confessor, who is said, but very improbably, there to have established the purity of her character, by walking unshrunk over nine burning plough-shares. In the reign of the same Edward, the broad seal of the chancellor of England was first made and kept in Winchester.

The Norman invasion produced many changes in the state of the city: there king William I. founded a castle, as he did in many other parts of the kingdom, with the view of overawing, under the pretence of protecting, the inhabitants. It continued, however, to be a principal royal residence, although London then began to assume the pre-eminence. The politic monarch knew the influence of the clergy over the people; he consequently assigned all or most of the chief offices in England to his relatives, dependants, and oftentimes friends. Councils were held in Winchester, in which the new clergy, with the primate Lanfranc at their head, drew up canons or laws levelled at the Saxons, and framed to protect or justify themselves. Winchester, the residence of the court, was of course filled with the prelates, the officers, and the followers of the king. The curfew (courve feu), or eight-o'clock-bell, was first rung in Winchester. The year 1079 is memorable in the history of Winchester, for then was commenced the present spacious and magnificent cathedral church. In the reign of Henry I. a singular transaction
transactiion is recorded to have taken place in Winchester. The current coin of the realm having been greatly debased by the different mint-masters, the king in 1125 assembled them in this city, when all, except three who dwelt in Winchester, were found guilty and severely punished. The bills were cried down, and an entirely new coinage ordered to be made by the three masters who had preferred their honesty. About the same period Henry caused to be made a standard yard, from the length of his own arm, in order to prevent frauds in the measurement of cloth. This standard is supposed to have been deposited with other measures, &c. in Winchester. The city suffered greatly in the ensuing conflagration on the death of Henry, by the struggle between his nephew Stephen and his daughter, the empress Matilda, or Maud. Stephen's party held the bishop's palace, the cathedral, and adjoining quarters, while Maud's possessed the castle and the remainder of the city. By fire from Stephen's party, the whole north portion, then the most populous, the royal palace, the abbey of St. Mary, and twenty churches, the magnificent monastery of St. Grimbald, the suburb of Hyde, &c. were destroyed.

Many privileges were conferred on Winchester by Henry II., in particular, in 1184, that of being governed by a mayor, with a subordinate bailiff. His successor, Richard Courte-ducion, was solemnly re-crowned in the cathedral in 1194, on his return from captivity under the duke of Austria. To the end of 1207 was born in Winchester Henry III.; and four years afterwards his father John, for the sum of 200 marks paid at once, and 100 marks per annum, conferred on the city all the great and unprecedented privileges of a corporation. Thus Winchester became the first of all the corporate cities or towns in the kingdom, nearly two years before London had even obtained the privilege of being governed by a mayor. The dignity of the city was in some measure reftored by the residence of Henry III. during his minority; but it again severely suffered in the contests between the king and the barons. A heavy blow on Winchester proceeded from the removal of the royal residence, in the reign of Edward I.; who nevertheless held several parliaments there. Under Edward III. it was constituted one of the fixed markets, or staple for wool; but by the removal of the staple in 1363, the decline of Winchester from commerce and wealth was sensibly uniform. In this reign the rebuilding of the nave of the cathedral was begun by bishop Edington; but the honour of completing it, with material alterations, was reserved for his celebrated successor, William of Wykeham. To Winchester Henry VI. was a considerable benefactor; for in his reign it was restored in trade and population, that the inhabitants, in a petition to the king, represented 997 houses to be unoccupied, and 17 churches shut up. The see of Winchester was held for a short time by cardinal Wolsey; but in the time of his successor, Gardiner, the final dissolution of the monasteries, and the consequent destruction of religious houses, reduced the city to be little more than the skeleton of what it had formerly been. It revived for a short time in the reign of Mary, who restored her union with Philip of Spain, and restored to the see many lands which had been alienated by her father and brother. The city itself, however, had, as appears by a charter of Elizabeth, fallen ‘‘into great ruin, decay, and poverty.’’

The commencement of 1623 was distinguished by the proclamation of James I. in Winchester, by the sole authority of the sheriff of the county, without waiting for the orders of the privy council in London, who had passed several hours in deliberation on the subject. In the civil wars of Charles I.'s time, Winchester was successively held by the opposite parties; but after the fatal battle of Naseby in 1645, it was finally reduced by Cromwell. The works of the castle were blown up, the fortifications of the city were destroyed, together with the bishop's castle of Wolvesey, and several churches, and other public buildings. During the latter part of the reign of Charles II. Winchester had a prospect of recovering some portion of its former splendour; for he chose it for his usual residence, when not required by presence in the capital. In imitation of his example, many of the nobility and gentry likewise erected mansions in the city; but by Charles's death in 1685, the project was laid aside; the palace was left unfinished; and so completely has its original definition since been changed, that, after being frequently used as a prison of war, it is now converted into military barracks for the district.

Fortifications: Palace.—The ancient walls of Winchester form an irregular parallelogram, inclosing a portion of the slope of the western hill, and of the level valley watered by the Itchen. But the walls are now nearly destroyed, and the foss in many places filled up. The four gates seemed to have been constructed where those of the Roman intrenchment were opened. Through two of them, on the north and south sides, passed the great Roman road communicating between Vindonum, now Silchester, and Clausentum, near Southampton. Through the gate in the west side of the inclosure, corresponding to the Praetorian gate of the intrenchment, ran the road communicating with Serdiodunum, where now stand the remains of Old Sarum. This gate still exists, but much altered from its ancient state: part of it is suppos'd to be coeval with the city walls, but the whole western face displays workmanship of much later date. The east or Decuman-gate opened access to the lively and wholesome waters of the Itchen.

The castle, now entirely destroyed, overlooking the city from the west, owes its origin to the system of dominion adopted by William of Normandy. Within its boundary, of an elliptic form, 850 feet from north to south, and in its greatest breadth 250 feet from west to east, stands the original chapel dedicated to St. Stephen, and apparently erected by the king of that name. It is in length 110 feet, divided into a nave and side-aisles. At the east end is suppos'd the antique curiofity called king Arthur's round-table; but with more accuracy attributed to king Stephen, and probably introduced by him to prevent disputes for precedence, during their entertainments, among the chivalrous valiant of that age. It is 18 feet in diameter, composed of stout oak planks, painted with the figure of the renowned Arthur, and the names of his twenty-four knights, as collected from the romances of the 14th and 15th centuries. The costume is, however, of the time of Henry VIII., when the table was painted. This chapel was, in Cromwell's time, converted into a county-hall, a destination to which it continues to be applied. In the year 1792, several thousands of French ecclesiastics fought refuge on the British shores. In their distressful situation, they were generously succoured by the state and the people; and at one time one thousand of them were accommodated with lodgings, and all other necessaries, in this deferted abode of royalty.

Winchester possessed also another fortrefs at the opposite end of the city: this was Wolvesey castle, the episcopal residence erected by the powerful bishop Henry de Blois, brother of king Stephen.

Cathedral.—The grand object of attraction in Winchester is its cathedral, one of the most interesting structures of its kind in England, whether considered with respect to the antiquity of its foundation, to the importance of the trans-
WINCHESTER.

sections of which it has been the scene, or to the characters of the personages whose mortal remains it contains. This magnificent and venerable structure has been called, and not without some propriety, a school of ecclesiastical architecture; for it displays to the student an interesting and varied series of examples of the ancient architecture of England, from an early age down to a recent period. If the student fail to satisfy himself as to Roman remains, or genuine Saxon work; if, after careful examination, he retire either doubtful or persuaded that no such architecture is there to be discovered; till he will have ample evidence and examples of Norman works. The plans and magnificent designs of those proud invaders and innovators are in that fabric amply displayed. There he will see that the Normans built not for themselves only, but for posterity; that their edifices were solid and substantial, simple in their forms, and large in their parts; that as their system of religion was intended to awe, terrify, and terrify the mind, to its primary temple in England was calculated most essentially to promote these ends.

The cathedral of Winchester is of great extent, its extreme external length being 556 feet, that of the crofs or transepts 230 feet; the external breadth of the whole body and choir 118 feet, and that of the transepts 88 feet. The body of the church is divided by ranges of clustered columns into a nave and two side-ailes, as are also the transepts, with the usual addition of aisles at the extremities. The great central tower rises upon four piers of great solidity, and rises 140 feet from the pavement. The present fabric may be considered as the foundation of bishop Walkelyn, a chaplain and relative of William of Normandy, who began it in 1279, constructing the crypts, the transepts, and tower; also the internal parts of the piers and walls of the nave. The work was continued under succeeding prelates, in particular by bishop de Lucy, who built part of the east end; by Edington, who erected the west front about 1330; and above all by Wykeham, who, between 1370 and 1400, brought the nave to completion. The exterior of the cathedral presents but few beauties, or attractive features. Its length of nave, plainness of masonry, shortness and solidity of tower, width of east end, and boldness of transepts, furnish, however, so many peculiar and specific characteristics. The interior of the cathedral will amply compensate for any defects or deficiencies of the outside. While the fine and sublime architecture of Wykeham, in the nave and aisles, produces the most impressive effect, and claims general admiration; the large, plain, and substantial works of Walkelyn, in the tower and transepts, are simply grand and imposing. The transepts and tower are entitled to attention, as unrivalled specimens of Norman architecture. The choir and eastern end are elevated above the nave and aisles, by an ascent of several steps; the choir itself occupying the space molily beneath the Norman tower, and fitted up with flails of elaborate workmanship. On the north side stands the pulpit, curiously carved in the time of Silkreade, who became prior in 1408. On the same side of the choir is placed the organ, in an unusual situation, under one of the lofty arches of the tower. The choir is separated from the nave by a screen of the Composite or Roman order of architecture, said to have been designed by Inigo Jones. The lofty stone screen erected behind the high altar is an elaborate and sumptuous work, covered with niches, canopys, buttracres, pinacles, crockets, pediments, &c.; and when in its original colour and condition, with statues and costly ornaments, must have been peculiarly splendid and beautiful. On entering the church by the well door, the attention is first arrested by the vast and lofty columns of the nave, which have been made to affimilate with the pointed style, by surrounding them with clustered shafts and other ornaments. Between the fifth and sixth columns, on the south side, stands the chantry or mortuary chapel, containing the tomb of bishop William of Wykeham, erected in his life-time, or prior to the clofe of the year 1404. On an altar-tomb within the chapel is the marble effigy of the founder. On the same side of the nave is the chantry of bishop Edington, who died in 1366; within an open screen is an altar-tomb supporting his effigy. Immediately behind the altar-screen in the south aisle is placed the sumptuous chantry of bishop Fox, containing neither tomb, flatue, nor inscription, to commemorate the founder, or to explain his works in the church. In a recess beneath is the effigy of an emaciated human figure, the head ornamented with a mitre, but the feet reposing on a skull. Opposite to this chantry in the north aisle stands that of bishop Gardiner, who died in 1555.

Towards the eastern extremity of the church are the chantries of cardinal-bishop Beaufort on the south side, and of bishop Waynflete, the magnificent founder of St. Mary’s college, Winchester, and Magdalen college, Oxford, on the north side; each containing the tombs and figures of the respective prelates. The eastern extremity of the church is terminated by the spacious Lady-chapel, with a smaller inlaid on each side. In the middle of the presbytery, between the choir and the altar, lies a coffin-tomb, said to cover the remains of William Rufus, who was killed while hunting in the New Forest, and buried in this cathedral in 1100.

On the top of the side-screens, between the present choir and the ailes, are placed six wooden canopies, the work of bishop Fox, containing memorials and relics of Saxon monarchs, princes, and other illustrious personages, former protectors and benefactors of the cathedral. Another object of undoubted antiquity is the curious font, now placed between two columns on the north side of the nave. It is a large square block of black marble, charged on each side with sculptures, the whole supported by small columns at the corners. The subject of the sculptures is a matter of dispute; and although as productions of art they are beneath criticism, yet as representations of costume, manners, implements, &c. they deserve particular attention.

Episcopal Castle, or Palace.—Of this structure, better known by the name of Wolvesey castle, the ruins shew it to have been an imperfect parallelogram of about 250 feet by 150. What still remains belonged to the keep. Much was removed to make way for the new palace erected by bishop Morley, under the superintendence of Sir Christopher Wren, after its destruction by Cromwell. The front of Morley’s palace was pulled down by the present bishop, who never occupies the present house.

College.—One of the most celebrated institutions of Winchester is the college, founded by bishop Wykeham, and completed in 1393, on the site of an ancient grammar-school; intending it as preparatory for its establishment of New college, Oxford. The establishment in Winchester consists of a warden, 70 scholars, 10 secular priests, who are perpetual fellows, 3 priests’ chaplains, 3 clerks, 16 choristers, and a first and a second master. So judicious and complete were the statutes drawn up by Wykeham for the government of his college in Winchester, as to be adopted, with very little alteration, by Henry VI., for his own splendid institutions at Eton and King’s college, Cambridge. On the confirmation, by Edward VI., of the general dissolution of colleges, &c. introduced by his father, Winchester college, with that of Eton and the universities, were specially excepted. The buildings of the college occupy a considerable extent of ground, and consist principally
principally of two courts, with a cloister. The entrance to the first court is under a spacious gateway, having the mutilated buls of a bishop and a king, to represent the founder and his royal patron, Edward III. The second court is also entered by a tower gateway. The chapel and hall form the south wing of the quadrangle, and are enlightened by lofty windows. The interior of the chapel has a fine and lofty vaulting, ornamented with traceried. In the centre of the cloister is the library, originally constructed for a chantry in 1439, but converted to its present use in 1627. In the south-west corner of the second court is the hall or refectory, between which and the passage to the chapel is the school, a plain brick building, erected by subscription in 1687; over the door is the statue of the founder in bronze, by Cibber.

City.—The present city of Winchester consists chiefly of one main street, extending from the west to the east, with a number of collateral streets and lanes branching off on each side. Towards the middle of the High-street stands the city cross, an elegant specimen of the style of the age of Henry VI., consisting of three stories adorned with open arches, niches, pinnacles, and small croffes. The ecclesiastical buildings in Winchester, and its suburbs, were once very numerous, and, according to some writers, amounted to upwards of ninety. Scarcey twelve now remain. St. Laurence's church, near the cross, is considered as the mother-church of the city, and by a solemn entry into it the bishop takes possession of his see; but the principal parochial church is now that of St. Maurice. The town-hall, or more properly the hall of the guild of merchants of Winchester, rebuilt in 1713, occupies the place of one erected about 1112. There the city archives, the original Winchester bulwark of king Edgar, and other measures of length and capacity fixed as standards by succeeding princes, and various curious memorials of antiquity, are now preferred. The front of the building is ornamented with a statue of queen Anne. A neat market-house was erected in 1772. The ancient building on the north side of the High-street, called St. John's House, was originally founded as an hospital, apparently fo early as in the 10th century; but falling into the possession or the administration of the knights templars, or of St. John of Jerusalem, it was on the suppression of their order granted by Edward II. to a citizen of Winchester, who re-founded the institution for the sick and lame. soldiery, pilgrims, and wayfaring men, to have their lodging and diet there gratis for one night or longer, as their inability to travel might require. At the general dissolution of hospitals and monasteries, the revenues and moveable property were seized by Henry VIII. St. John's, but the corporation of the city referred the building itself to be used for municipal business. In 1554 it again became a charitable foundation, being endowed by Richard Lamb, Esq., for the support of six widows. The principal chamber or hall, which is 62 feet in length, 38 in breadth, and 28 in height, has been handsomely fitted up, chiefly by a donation from the late colonel Brydges of Avington. Among the decorations of this hall, in which public feasts, music-meetings, and assemblies are held, is a whole-length picture of Charles II. by Lely, presented to the city by that king himself. In the adjoining council-chamber are suspended the city tables, as they are called, containing a chronological arrangement of the most remarkable occurrences relating to Winchester. The ancient chapel of the hospital is now used as a Free-school. The celebrated monastery founded by the great Alfred, called the Newen Mynstre, and afterwards Hyde abbey, occupied nearly the whole space between the cathedral and the High-street. Completed under his son Edward, it was first filled by canons regular, who, in 963, gave place to Benedictine monks. Alwyn, the eighth abbot, with twelve of his monks, fell in the battle of Hatfield, in supporting the cause of his nephew, Harold, which drew upon the abbey the vengeance of William of Normandy. But the position being unhealthy and inconvenient, a new and magnificent church and monastery were erected without the north wall of the city, on the spot called Hyde-meadow, to which the monks removed in 1110, carrying with them the remains of several illustrious personages who had been buried in the former abbey, among which were those of Alfred himself and some of his descendants. The annual revenues of Hyde abbey, of which the abbot was in parliament, were at the dissolution valued at 865l. 18s. The church and monastery were soon afterwards demolished, and even the tombs of Alfred and other eminent personages were defiled. What now remains of this institution is the small and mutilated parish-church of St. Bartholomew. Precisely on the place occupied by the abbey-church was some time ago erected a bridge, or house of correction, on the plan of the benevolent Howard. In digging the foundations, stone coffins, rings, and vessels for the service of the church, were disinterred, together with fragments of architectural sculpture. But between fifty and sixty years ago, among the remains of the buildings, was found a bronce with this inscription in Saxon characters, 'Alfred Rex DCCCCLXXXI.' Another remarkable religious establishment in Winchester was the Nunna Mynstre, or abbey of St. Mary, founded by Alfred's queen, Alfswitha, and the place of her retirement after his death. Scarcely any vestige of the conventual buildings now remain, excepting in a modern mansion built out of the ancient materials, and the name of the abbey still applied to the inclosure where it stood.

Winchester, besides the numerous churches of the establishment, contains meeting-houses for dissenters of various denominations, among which the principal building is the Roman Catholic chapel, rebuilt by Dr. Milner in 1792, on the foundations of one more ancient. A large and commodious county-gaol, from the designs of Mr. Mouncey, has been lately erected on the north side of the city.

Many privileges have at various times been bestowed on Winchester by English sovereigns. Its chief magistrate, as was before noticed, received the title of mayor in 1384, some years before the title was granted to the chief magistrate of London. The first charter was conferred by king John; but that under which the city is now governed was the gift of Elizabeth, "in consideration," as it is stated, '"of the city of Winchester having been most famous for the celebration of the nativities, coronations, feuphreus, and for the preservation of other famous monuments of the queen's progenitors.' By this charter, the government is vested in a mayor, recorder, six aldermen, a town-clerk, two coroners, two constables, and a council of twenty-four of the "better, discreet, and more honest" inhabitants. The first return of representatives to parliament for Winchester took place in the twenty-third year of Edward I. The right of election is vested in the corporation.

Winchester possesses very little trade but what arises from its situation in the centre of an extensive and populous county. An ancient wool-combing manufacture, however, is still in existence, and of late years the silk manufacture has been introduced. All the public business of Hampshire is transacted in Winchester, which occasions a frequent and ample influx of strangers from all quarters. The cathedral and the college secure to the city the residence of a number of superior clergy. When in the height of its prosperity, and poifting the benefit of the wool-staple, the wealth of the inhabitants was greatly increased by the multi-
itudes referring to its fairs, the principal of which was held on the neighbouring hills of St. Giles and St. Mary Magdal.

St. Giles's fair was, at one time, by far the greatest in England. By a grant from William the Conqueror, it was originally to be held for one day only; but by Henry II. its duration was enlarged to sixteen days; and in that time no mercantile business was permitted to be transacted in Southampton, nor in any other place within seven leagues of St. Giles's hill. This fair has long become very insignificant; that of St. Mary Magdalen is still, however, much frequented. Since the year 1770, various improvements have been made in the general appearance of the city, by paving, repairing, and cleaning. As early as 1736 was established in Winchester an hospital or infirmary for the county, a very useful institution, conducted on a plan judicious in itself, and honourable to those entrusted with its administration. According to the parliamentary returns of 1811, the number of benefactions comprising the city and suburbs was 1134, and the inhabitants 6705.

Hospital of St. Cross.—About a mile south from Winchester, in the valley watered by the Itchen, stands the venerable hospital of the holy cross; an institution still retaining more of its original character. "The lofty tower," observes Dr. Milner, "with the grated door and porter's lodge beneath it, the retired ambulatory, the separate cells, the common refectory, the venerable church, the flowing black drapery, and the silver cross worn by the members, the conventual appellation 'brother' with which they address one another, the silence, the order, the neatness, in short, that reign here, seem to recall the idea of a monastery to those who have seen one, and will give no imperfect idea of such an establishment to those who have not had that advantage." But this establishment was never a monastery, being only an hospital originally founded by bishop Henry de Blois, between 1132 and 1136, for the residence and maintenance of thirteen poor men, and the relief of a hundred others of the most indigent of the city, but of creditable character. Each of these was to be provided daily with a loaf of bread, three quarters of small beer, and two melleys for his dinner, in a hall appointed for the purpose. In the hospital was an endowed place for a master, a clerk, four chaplains, thirteen clerks, and seven choristers. Before the time of William of Wykeham, bishop of Winchester in 1366, the revenues of St. Croes had been employed in a way very different from the intentions of the founder; but that munificent prelate succeeded, after long litigation, in restoring the institution to its original uses, re-establishing it on a secure and well-ordered foundation. The plan was afterwards refumed and enlarged by cardinal-bishop Beaufort, for the additional support of two priests and thirty-five religious poor men; he also rebuilt a considerable portion of the hospital. The present establishment of St. Croes is but the wreck of its ancient institutions, having been severely fleeced, though not quite destroyed, like many other charitable establishments, at the Reformation. Instead of seventy residents, clergy and laity, entirely supported in the place, and one hundred out-pensioners, the institution at present confits of but ten refiding brethren, and three out-pensioners, with one chaplain and the master. Certain doles of bread, it is true, continue to be distributed to the poor of the neighbourhood; and, as perhaps the only vestige remaining in the kingdom of the simple hospitality of ancient days, the porter is daily furnished with a certain quantity of good bread and beer, of which every traveller, or other person whatever, who knocks at the lodge and calls for relief, is entitled to partake gratuitously. The buildings of the hospital once composed two courts; but the fourth side of the interior quadrangle has been of late years pulled down. On the east side of the outer court is the 'hundred-menne's hall,' about forty feet long, now converted into a brewhouse; on the south side is the handsome tower-gateway, with the statue of the founder, Beaufort, in the upper part. In the second, or inner court, is the church, built in the cathedral form, with a nave and transepts, and a low massive tower at their interfrontion. The architecture of the edifice is singularly curious, as it throws some light on the progress, if not on the origin, of the pointed, or English style. The whole edifice seems to be a collection of architectural essays, with respect to the form and the disposition, of both the essential parts and the subordinate ornaments. It presents the ponderous pillar of a height equal to its circumference, but supporting an incipient pointed arch. The lower part of the nave contains massive Norman pillars; and the portal of the west front is an elegant specimen of the time of King John, or beginning of that of Henry III. The west wing of the remaining buildings contains the apartments of the Brethren, each of whom has for his own use three chambers and a separate garden. Adjoining to the hall on the north side are the apartments of the master, which are spacious and convenient; and on the east side is the ambulatory or open portico for exercise.

St. Catherine's Hill, or College Hill, separated from the meadows of St. Croes by the branches of the Itchen, is remarkable for the intrenchment carried round its summit: the former name it acquired from an ancient chapel on it, deprived of its endowments by cardinal Wolsey; the latter, because it is a frequent place of resort for the students of the college.

About three miles north-east from Winchester lies Avington, anciently Abingdon, a seat and manor of the present marquis of Buckingham, in conformance of his marriage with the sole daughter and heir of James, the late duke of Chandos. The manor, originally a royal demesne, was granted, in 1561, by king Edward to the monastery of St. Swithun, in Winchester; but in conformance of the diolution, it became, in the reign of Elizabeth, the property of the ancient family of Bruges, or Brydges, first settled in Shropshire at the Conquest. Inter-marrying with the family of lord Chandos, renowned in the wars in France under Edward III., the honours of the two families have ever since continued united. Avington is situated in a secluded valley, well planted and nearly inclosed by high downs. The present mansion is of brick, and has been greatly improved by the present possessor, having been previously dismantled by the late duke, for the purpose of adding two wings. Some of the apartments are fitted up with great elegance, and enriched by a selection of excellent paintings. The park formed by the late duke, about three miles in circumference, contains a piece of water supplied by the river Itchen.—History, &c. of Winchester, by the Rev. John Milner, D.D. F.S.A., 2 vols. 4to. 2d edit. 1809. Beauties of England, vol. vii. Hampshire, by J. Britton and E. W. Brayley. History, &c. of Winchester Cathedral, by J. Britton, 1 vol. 4to. with 30 Prints.

Winchester, a town of New Hampshire, in the country of Cheshire, with 1478 inhabitants; 13 miles S.E. of Chesterfield.—Allo, a town of the state of Connecticut, in Litchfield county, with 1466 inhabitants; 22 miles N.W. of Hartford.—Allo, a town of the state of Kentucky, with 4 churches, and 2000 inhabitants.

Winchester, or Fredericktown, a town of Virginia; 56 miles W.N.W. of Washington. N. lat. 39° 15'. W. long. 78° 27'.

Winching, in the Manges, is said of a horse when he kicks, spurs, or throws out his hind feet.
WINCKHEIM, in Geography, a town of the duchy of Wurzburg; 4 miles N.N.W. of Lauringen.

WINCRANTUM, in Natural History, a name given by the people of the East Indies to a sciolie substance resembling, in some degree, the plated lead ores of Europe, but containing very little of that metal; it is properly a species of blende, or mock-lead, of a tacky appearance; it is confiderably hard, and is usually found in other stones. It is given in medicine in the Indies as a provocative to venery, being first calcined and beat to powder.

WIND, VENTUS, a fenfible agitation of the air, by which a large quantity of it flows in a current or stream out of one place, or region, into another. See Meteorology.

The winds are divided into perennial, flated, and variable. They are also divided into general and particular.

WINDS, Perennial or Constant, are such as always blow the same way.

Of these we have a very notable one between the two tropics, blowing conftantly from east to west; called the general trade-wind.

WINDS, Stated or Periodical, are such as constantly return at certain times. Such are the sea and land breezes, blowing from sea to land in the evening; and from land to sea in the morning.

Such also are the shifting or particular trade-winds, which, for certain months of the year, blow one way, and the reft of the year the contrary way. See Trade-Winds.

WINDS, Variable or Erratic, are such as blow now this, now that way; and are now up, now hufhed, without any rule or regularity, either as to time or place.

Such are all the winds observed in the inland parts of England, &c. though few of these claim their certain times of the day. Thus, the west wind is moft frequent about noon; the south wind in the night; the north in the morning, &c.

WIND, General, is such a one, as at the fame time blows the fame way, over a very large tract of ground, almoft all the year. Such only is the general trade-wind.

But even this has its interruption: for, 1. At land it is scarcely fenfible at all, as being broken by the interpoftion of mountains, valleys, &c. 2. At sea, near the shore, it is disturbed by vapours, exhalations, and particular winds, blowing from landward; fo that it is chiefly confidered as general, only at mid-sea: where, 3. It is liable to be disturbed, by clouds driving from other quarters.

WINDS, Particular, include all others, excepting the general trade-winds; which fee.

Those peculiar to one little canton, or part, are called topical or provincial winds. Such is the north wind, on the western side of the Alps, which does not blow above one or two leagues lengthwise, and much less in breadth: such also is the pontias in France, &c.

WINDS, Physical Cause of: Some philosophers, as Des Cartes, Rohault, &c. account for the general wind, from the diurnal rotation of the earth, and from this general wind derive all the particular ones. The atmopherfe, fay they, invelling the earth, and moving round it; that part will perform its circuit fooneft which has the fmalleft circle to defcribe: the air, therefore, near the equator, will require a fowemwhat longer time to perform its course in, from west to eaf't, than that nearer the poles.

Thus, as the earth turns eastward, the particles of the air near the equinoctial, being exceedingly light, are left behind; fo that, in refpect of the earth's surface, they move eastwards, and become a confiant eaf'terly wind.

This opinion seems confirmed by this, that these winds are found only between the tropics, in thofe parallels of latitude where the diurnal motion is fweeter. But the confant calms in the Atlantic sea near the equator, the wefterly winds near the coast of Guinea, and the periodical wefterly monfoons under the equator in the Indian seas, declare the infufficiency of this hypothesis.

Besides, the air, being kept close to the earth by the principle of gravity, would, in time, acquire the fame degree of velocity that the earth's surface moves with, as well in refpect of the diurnal rotation, as of the annual, about the fun, which is about thirty times fweeter. See Trade-Winds.

Dr. Halley, therefore, substitutes another cafe, capable of producing a like confant effect, not liable to the fame objections, but agreeable to the known properties of the elements of water and air, and the laws of the motion of fluid bodies. Such a one is the action of the sun's beams upon the air and water, as he paffes every day over the ocean, confidered together with the quality of the fand, and the situation of the adjoining continents.

According to the laws of statics, the air, which is lefs rarefied or expanded by heat, and confequently is more ponderous, muft have a motion towards thofe parts of it which are more rarefied, and lefs ponderous, to bring it to an equilibriwm; alfo, the preience of the sun continually shifting to the wef'tward, that part towards which the air bends, by reafon of the rarefation made by his greateft meridian heat, is, with him, carried wef'tward; and, confequently, the tendency of the whole body of the lower air is that way.

Thus a general eaf'terly wind is formed, which being impressed upon the air of a vaf't ocean, the parts impel one the other, and fo keep moving till the next return of the fun, by which fo much of the motion as was loft is again restored; and thus the eaf'terly wind is made perpetual.

From the fame principle it follows, that this eaf'terly wind fhould, on the north fide of the equator, be to the northward of the eaf't, and in fouth latitudes to the fouthward of it; for, near the line, the air is much more rarefied than at a greater diftanee from it; becaufe the fun is twice in a year vertical there, and at no time distant above 23½ degrees; at which diftanee, the heat, being as the fane of the angle of incidence, is but little short of that of the perpendicular ray; whereas under the tropics, though the fun ray longer vertical, yet he is a long time 47 degrees off, which is a kind of winter, in which the air is cooler, as that the fummer heat cannot warm it to the fame degree with that under the equator. Wherefore, the air towards the north and fouth being lefs rarefied than that in the middle, it follows, that from both fides it ought to tend towards the equator.

This motion, compounded with the former eaf'terly wind, accounts for all the phenomena of the general trade-winds, which, if the whole surface of the globe was fweeter, would undoubtedly blow quite round the world, as they are found to do in the Atlantic and the Ethiopic oceans. But feeing that fo great continents do interpofe, and break the con tinuity of the ocean, regard muft be had to the nature of the fand, and the poftition of the high mountains, which are the two principal caufes of the variations of the wind from the former general rule; for if a country lying near the fun prove to be flat, sandy, and low land, fuch as the deferts of Lybia are ufually reported to be, the heat occasioned by the refexions of the fun's beams, and the retention of it in the fand, is incredible to thofe who have not felt it; by which the air being exceedingly rarefied, it is neceffary that the cooler and more dense air fhould run thitherwards, to reftore the equilibrium. This is supposed to be the caufe, why, near
near the coast of Guinea, the wind always sets in upon the land, blowing westerly instead of easterly, there being sufficient reason to believe that the inland parts of Africa are prodigiously hot, since the northern borders of it were so very intertemperate, as to give the ancients cause to conclude that all beyond the tropics was uninhabitable by excess of heat.

Mr. Clare, in his Motion of Fluids, p. 302. mentions a familiar experiment, that serves to illustrate this matter, as well as the alternate converse of land and sea breezes. Fill a large dish with cold water, and in the middle of it place a water-plate, filled with warm water: the first will represent the ocean, the other an island, rarely the air above it. Then holding a wax-candle over the cold water, blow it out, and the smoke will be seen, in a still place, to move toward the warm plate, and ribbing over, it will point the course of the air (and also of vapour) from sea to land. And if the ambient water be warm, and the plate filled with cold water, and the smoking wax-candle of a hook held over the plate, the contrary will happen. (See Breeze.) For the phenomena of the wind observed by Dr. Halley, and explained by his theory, see Wind, in Navigation.

From the same cause it happens, that there are more constant calms in that same part of the ocean, called the rains; for this tract being placed in the middle, between the westerly winds blowing on the coast of Guinea, and the easterly trade-winds blowing to the westward of it; the tendency of the air here is indifferent to either; and so stands in equilibrium between both; and the weight of the incumbent atmosphere being diminished by the continual contrary winds blowing from hence, is the reason that the air here holds not the copious vapour it receives, but lets it fall in frequent rains.

But, as the cold and dense air, by reason of its greater gravity, presses upon the hot and rarefied, it is demonstrable that this latter must ascend in a continued stream as fast as it rarefies; and that, being ascended, it must disperse itself, to preserve the equilibrium; that is, by a contrary current, the upper air must move from those parts where the greatest heat is, fo, by a kind of circulation, the north-east trade-wind below will be attended with a south-westerly wind above; and the south-east, with a north-west wind above.

That this is more than a bare conjecture, the almost instantaneous change of the wind to the opposite point, which is frequently found in passing the limits of the trade-winds, seems strongly to assure us; but that which above all confirms this hypothesis, is the phenomenon of the monsoons, by this means most easily solved, and without it hardly explicable. See Monsoons.

Supposing, therefore, such a circulation as above, it is to be considered, that to the northward of the Indian ocean there is everywhere land, within the usual limits of the latitude of 30°; viz. Arabia, Persia, India, &c., which, for the same reason as the Mediterranean parts of Africa, are subject to insufferable heats when the sun is to the north, passing nearly vertical; but yet are temperate enough when the sun is removed towards the other tropic, because of a ridge of mountains at some distance within the land, said to be frequently, in winter, covered with snow, over which the air, as it paffes, must needs be much chilled. Hence it happens, that the air coming, according to this general rule, out of the north-east, to the Indian sea, is sometimes hotter, sometimes colder, than that which, by this circulation, is returned out of the south-west; and, by consequence, sometimes the under-current, or wind, is from the north-east, sometimes from the south-west.

Which these winds set, viz. in April; when the sun begins to warm these countries to the north, the south-west monsoons begin, and blow, during the heats, till October, when the sun being retired, and all things growing cooler northward, and the heat increasing to the south, the north-east winds enter, and blow all the winter till April again. And it is, undoubtedly, from the same principal, that to the southward of the equator, in part of the Indian ocean, the north-west winds succeed the south-east, when the sun draws near the tropic of Capricorn. Phil. Tranf. No. 185. or Abrig. vol. ii. p. 139.

Some philosophers, dissatisfied with Dr. Halley's theory above recited, or not thinking it sufficient for explaining the various phenomena of the wind, have had recourse to another cause, viz. the gravitation of the earth and its atmosphere towards the sun and moon, to which the tides are confessedly owing. See Tides.

From the laws of universal attraction it has been inferred, that these celestial bodies must act upon the atmosphere, or that they must occasion a flux and reflux of the atmosphere, as well as of the ocean. Hence it has been alleged, that though we cannot discover aerial tides, of ebb or flow, by means of the barometer, because columns of air of unequal height, but different density, may have the same pressure or weight; yet the protuberance in the atmosphere, which is continually following the moon, must, they say, of course produce a motion in all parts, and fo produce a wind more or less to every place, which, conspiring with or counteracted by the winds arising from other causes, makes them greater or less. Several dissertations to this purpose were published, on occasion of the subject proposed by the Academy of Sciences at Berlin, for the year 1746.

Although the atmospheric air is much more variable than water, and the action of the sun and moon upon it becomes much less apparent to us, because they must frequently counter with or be counteracted by the much more powerful effects of heat and cold, of dryness and moisture, of winds, &c. so that their action upon the barometer has been long disputed and even denied, (see Moon, Influence of) yet that the moon in particular, as well as the sun, has such an action has been for a considerable time surmised; and of late years it has been in a degree observed and rendered sensible by means of very accurate and long-continued barometrical observations, and perceived only by taking a mean of the observations of many years.

Toaldo, the learned astronomer of Padua, after a variety of observations made in the course of several years, found reason to assert, that, ceteris paribus, at the time of the moon's apogee, the mercury in the barometer rises the 0.105 of an inch higher than at the perigee; that at the time of the quadratures, the mercury stands 0.008 of an inch higher than at the time of the syzygies; and that it stands 0.022 of an inch higher when the moon in each lunation comes nearest to our zenith, (meaning the zenith of Padua, where the observations were made,) than when it goes farthest from it. Journal des Sciences Utiles.

In the seventh volume of the Philosophical Magazine, there is a paper of L. Howard, esq., which contains several curious observations relative to this subject. This gentleman found, both from his own observations, and from an examination of the Meteorological Journal of the Royal Society, which is published annually in the Philosophical Transactions, that the moon had a manifest action upon the barometer. "It appears," he says, "to me evident, that the atmosphere is subject to a periodic change of gravity, by which the barometer, on a mean of ten years, is depressed at least one-tenth of an inch while the moon is passing from the 3 P quarters
WIND.

quarters to the full and new; and elevated, in the same proportion, during the return to the quarter. A great fall of the barometer generally takes place before high tides, especially at the time of new or full moon.

The canes, it is said, which render the diurnal tide of the atmosphere sensible to us, may be the elasticity of the air, and the interference of the much more powerful effects of heat, cold, vapours, &c.

It has been calculated by D'Alembert, from the general theory of gravitation, that the influence of the sun and moon in their daily motions is sufficient to produce a continual east wind about the equator. So that, upon the whole, we may reckon three principal daily tides, viz., two arising from the attractions of the fun and moon, and the third from the heat of the sun alone; all which sometimes combine together, and form a prodigious tide.

In corroboration of the opinion of the influence of the sun, and principally of the moon, in the production of wind, we must likewise mention the observations of Bacon, Gaffendi, Dampier, Halley, &c.; namely, that the periods of the year most likely to have high winds are the two equinoxes; that storms are more frequent at the time of new and full moon, especially those new and full moons which happen about the equinoxes; that, at periods otherwise calm, a small breeze takes place at the time of high water; and that a small movement in the atmosphere is generally perceived a short time after the moon and the midnights of each day.

M. Mučhenbroek, however, will not allow that the attraction of the moon is the cause of the general wind; because the east wind does not follow the motion of the moon about the earth; for in that case there would be more than twenty-four changes, to which it would be subject in the course of a year, instead of two. Intro. ad Phil. Nat. vol. ii. p. 1103.

Some action in the production of wind may also be derived from volcanoes, fermentations, evaporation, and especially from the condensation of vapours: for we find that, in rainy weather, a considerable wind frequently precedes the approach of every single cloud, and that the wind subsides as fast as the cloud has passed over our zenith.

Wherever any of the above-mentioned causes are constantly more predominant, as the heat of the sun within the tropics, there a certain direction of the wind is more constant; and where different causes interfere at different and irregular periods, as in those places which are considerably distant from the torrid zone, there the winds are more changeable and uncertain.

In short, whatever disturbs the equilibrium of the atmosphere, viz. the equal density or quantity of air at equal distances from the surface of the earth; whatever accumulates the air in one place, and diminishes it in other places, must occasion a wind both in disturbing and in reestablishing that equilibrium, as above stated.

Mr. Henry Eales, apprehending that the sun's rarefying of the air cannot singly be the cause of all the regular and irregular motions which we find in the atmosphere, attributes them to another cause, viz. the ascent and descent of vapour and exhalation, attended by the electrical fire or fluid; and on this principle he has endeavoured to explain at large the general phenomena of the weather and barometer. Phil. Trans. vol. xvi. art. 25. p. 124.

M. Brilhon (Principes de Physique) also is of opinion that electricity is the principal and more general cause which produces winds; but Mr. Cavallo is of a different opinion.

After making various observations on the nature and theory of winds, Dr. Darwin recapitulates his opinions in the following manner. 1. The north-east wind consists of air flowing from the north, where it seems to be occasionally produced; and has an apparent direction from the east, owing to its not having acquired in its journey the increasing velocity of the earth's surface. These winds are analogous to the trade-winds between the tropics, and frequently continue in the vernal months for four or six weeks together, with a high barometer, and fair and frosty weather. They sometimes consist of south-west air, which had passed by us or over us, driven back by a new accumulation of air in the north; and they continue but a day or two, and are attended with rain.

2. The south-west wind consists of air flowing from the south, and seems occasionally absorbed at its arrival to the more northern latitudes. It has a real direction from the west, owing to its not having lost in its journey the greater velocity it had acquired from the earth's surface from whence it came. These winds are analogous to the monsoons between the tropics, and frequently continue for four or six weeks together, with a low barometer, and rainy weather. They sometimes consist of north-east air, which had passed by us, and which becomes retrograde by a commencing deficiency of air in the north. These winds continue but a day or two, attended with heavy frosts, with a sinking barometer; their cold being increased by their expansion as they return into an incipient vacancy.

3. The north-east wind consists of air flowing from the north, which have been passed over, been blown down, and driven back towards the south by newly-generated northern air. They continue but a day or two, and are attended with rain or clouds. They consist of north-east winds blown down from the higher parts of the atmosphere, and having there acquired a greater velocity from the earth's surface than frosty and fair. They consist of north-east winds formed into a vertical eddy, not a spiral one, with frost or fair.

4. The north winds consist of air flowing slowly from the north, so that they acquire the velocity of the earth's surface as they approach it; they are fair or frosty, but seldom occur. They consist of retrograde south winds; these continue but a day or two, are preceded by south-west winds, and are generally succeeded by north-east winds, cloudy or rainy weather, the barometer rising.

5. The south winds consist of air slowly flowing from the south, losing their previous colder velocity by the friction of the earth's surface as they approach it; they are moist, but seldom occur. They consist of retrograde north winds; these continue but a day or two, and are preceded by north-east winds, and are generally succeeded by south-west winds, colder, and the barometer sinking.

6. The east winds consist of air brought hastily from the north, and not impelled farther southward, owing to a sudden beginning absorption of air in the northern regions; they are very cold, the barometer high, and are generally succeeded by south-west winds.

7. The west winds consist of air brought hastily from the south, and checked from proceeding farther to the north, by a beginning production of air in the northern regions; they are warm and moist, and generally succeeded by north-east winds. They consist of air bent downwards from the higher regions of the atmosphere; if this air be from the south, and brought hastily, it becomes a wind of great velocity, moving perhaps 60 miles in an hour, and is warm and rainy; if it consists of northern air bent down it is of less velocity, and cooler.

Various other interesting remarks and reflections on winds may be seen in the notes to the Botanic Garden, by the same writer.
The industry of some late writers having brought the theory of the production and motion of winds to somewhat of a mathematical demonstration; we shall here give it the reader in that form.

WINDS, Laws of the Production of. If the spring of the air be weakened in any place, more than in the adjoining places; a wind will blow through the place where the diminution is.

For, 1. Since the air endeavours, by its elastic force, to expand itself every way; if that force be less in one place than another, the effort of the more against the less elastic, will be greater than the effort of the latter against the former. The less elastic air, therefore, will refill with less force than it is urged by the more elastic: consequently, the less elastic will be driven out of its place, and the more elastic will succeed.

If, now, the excess of the spring of the more elastic above that of the less elastic air, be such as to occasion a little alteration in the baroscope; the motion both of the air expelled, and that which succeeds it, will become sensible, i.e. there will be a wind.

2. Hence, since the spring of the air increases, as the compressible weight increases, and compressed air is denser than air less compressed; all winds blow into rarer air, out of a place filled with a denser.

3. Wherefore, since a denser air is specifically heavier than a rarer; an extraordinary lightness of the air in any place must be attended with extraordinary winds or storms.

Now, an extraordinary fall of the mercury in the barometer, fleeing an extraordinary lightness of the atmosphere, it is no wonder if that foretold storms. See Barometer.

4. If the air be suddenly condensed in any place, its spring will be suddenly diminished; hence, if this diminution be great enough to affect the barometer, there will a wind blow through the condensed air.

5. But since the air cannot be suddenly condensed, unless it have before been much rared, there will a wind blow through the air, as it cools, after having been violently heated.

6. In like manner, if air be suddenly rared, its spring is suddenly increased; wherefore, it will flow through the contiguous air, not acted on by the rarefying force. A wind, therefore, will blow out of a place, in which the air is suddenly rared; and on this principle, in all probability, it is, that,

7. Since the sun’s power in rarefying the air is notable, it must necessarily have a great influence on the generation of winds.

8. Mott caves are found to emit wind, either more or less. M. Mufchenbroek has enumerated a variety of causes that produce winds, existing in the bowels of the earth, on its surface, in the atmosphere, and above it. See Intr. ad Phil. Nat. vol. ii. p. 1116, &c.

The rising and changing of the wind are determined experimentally, by means of weather-cocks, placed on the tops of houses, &c. \[ \text{But these only indicate what passes about their own height, or near the surface of the earth: Wol-} \]
\[ \text{fius affords us, from observations of several years, that the} \]
\[ \text{higher winds, which drive the clouds, are different from the} \]
\[ \text{lower ones, which move the weather-cocks. And Dr.} \]
\[ \text{Derham observes something not unlike this. Phys. Theol.} \]
\[ \text{lib. i. cap. 2.} \]

The author last-mentioned relates, upon comparing fe-
\[ \text{veral series of observations made of the winds in divers} \]
\[ \text{countries; viz. England, Ireland, Switzerland, Italy,} \]
\[ \text{France, New England, &c. that the winds in these fe-} \]
\[ \text{veral places seldom agree; but when they do, it is com-} \]
monly when they are strong, and of long continuance in the same quarter; and more, he thinks, in the northern-} 
\[ \text{and easterly than in other points. Also, that a strong wind in one place is oftentimes a weak one in another, or mo-} \]
\[ \text{derate, according as the places are nearer, or more remote.} \]
\[ \text{Phil. Trans. N° 267 and 321.} \]

WIND, Laws of the Force and Velocity of. Wind being only air in motion, and air being a fluid subject to the laws of other fluids, its force may be regularly brought to a pre-
cise computation: thus, ‘The ratio of the specific gravity of any other fluid to that of air, together with the space that fluid, impelled by the preffure of the air, moves in any given time, being given: we can determine the space through which the air itself, acted on by the same force, will move in the same time.’ By this rule:

1. As the specific gravity of air is to that of any other fluid; so, reciprocally, is the square of the space, which that fluid, impelled by any force, moves in any given time, to the square of the space which the air, by the same impulfe, will move in the same time.

Supposing, therefore, the ratio of the specific gravity of that other fluid to that of air, to be \( \frac{b}{c} \); the space described by the fluid to be called \( s \) and that which the air will describe by the same impulfe, \( x \). The rule gives

\[ x = \sqrt{\frac{b}{c}} s. \]

Hence, if we suppose water impelled by the given force, to move two feet in a second of time, then will \( s = 2 \); and since the specific gravity of water to the air is as 800 to 1, we shall have \( b = 800c \) and \( c = 1 \); consequently, \( s = \sqrt{800 \times 4} = \sqrt{3200} = 57 \) feet nearly.

The velocity of the wind, therefore, to that of water, moved by the same force, will be as 57 to 2; i.e. if water move two feet in a second, the wind will fly 57 feet.

2. Add, that \( x = \sqrt{\frac{c}{b}} s \); and therefore the space any fluid, impelled by any impression, moves in any time, is determined, by finding a fourth proportional to the two numbers that express the ratio of the specific gravities of the two fluids, and the square of the space the wind moves in, in the given time. The square root of that fourth proportional is the space required.

Mr. Mariotte, \( a, gr. \) found, by various experiments, that a pretty strong wind moves 24 feet in a second of time, which is at the rate of 1440 in a minute; \( i.e. \) at the rate of somewhat more than 16 miles in an hour: wherefore, if the space which the water, acted on by the same force as the air, will describe in the same time, be required; then will \( c = 1, s = 24, b = 800 \); and we shall find \( x = \sqrt{\frac{576}{800}} = \frac{24}{5} \) nearly.

Derham estimated the velocity of the wind in very great storms at 66 feet per second; and de la Condamine at 904 feet per second.

3. ‘The velocity of wind being given, to determine the preflure required to produce that velocity,’ we have this rule. The space the wind moves in one second of time, is to the height a fluid is to be raised in an empty tube, in order to have a preflure capable of producing that velocity, in a ratio compounded of the specific gravity of the fluid to that of air, and of quadruple the altitude
WIND.

Altitude a body descends in the first second of time, to the
aforeaid space of the air.

Suppose, \( r \), gr. the space through which the air moves
a second, \( a = 24 \) feet, or 288 inches; call the alti-
itude of the fluid \( x \); and the ratio of mercury to air,
\[
\frac{b}{c} = \frac{800 \times 14}{1} = \frac{11200}{1};
\]
and the altitude through which
a body descends in the first second of time, 16 feet 1
inch; then, by the theorem, we shall have \( 288 : x ::
11200 \times 762 : 288 \), and consequently
\[
x = \frac{11200 \times 762}{288} = 11200 \times 762
\]
= .01, &c. of an inch. Hence we see why a small
but sudden change in the barometer is followed with
violent winds. See an account of the principle upon
which these calculations are founded under the article WATER.

When the direction of the wind is not perpendicular, but
oblique to the surface of the solid, then the force
of the former upon the latter will not be so great as when the
impulse is direct, and that for reasons which are easily derived
from the theory of the resolution and composition of forces,
and from the theory of direct and oblique impulses. In
short, the general proposition for compound impulses is, that
the effective impulse is as the surface, as the square of the
air's velocity, as the square of the sine of the angle of inci-
dence, and as the sine of the obliquity of the solid's motion
to the direction of the impulse, jointly; for the alteration of
every one of those quantities will alter the effect in the same
proportion. But these general rules, as we have already
more than once observed, are subject to great variations; so
that their results seldom coincide with those of actual
experiments.

Philosophers have used various methods for determining
the velocity of the wind, which is very different at different
times. The method used by Dr. Derham was that of
letting light downy feathers fly in the wind, and accurately
observing the distance to which they were carried in any
number of half seconds. This method he preferred to that
of Dr. Hooke's mola alata, or pneumatica. (See Phil. Tran.
No. 24, and Birch's Hill. Roy. Soc. vol. iv. p. 225.)
He tells us, that he thus measured the velocity of the wind
in the great storm of August, 1705, and by many experi-
ments found, that it moved at the rate of thirty-three feet
per half-second, or of forty-five miles per hour: whence he
concludes, that the most vehement wind (as that of Novem-
ber, 1703) does not fly at the rate of above fifty or sixty
miles per hour, and that at a medium the velocity of wind is
at the rate of twelve or fifteen miles per hour. Phil. Tran.
No. 313, or Abr. vol. iv. p. 411.

Mr. Brice observes, that experiments with feathers are
subject to uncertainty: as they seldom or ever descibe a
straight line, but describe a sort of spirals, moving to the
right and left, and rising to very different altitudes in their
progress. He, therefore, considers the motion of a cloud,
or its shadow, over the surface of the earth, as a much more
accurate measure of the velocity of the wind. In this way
he found, that the wind, in a considerable gale, moved at
the rate of 62.9 miles per hour; and that, when it blew a
fresh gale, it moved in the same time about twenty-one
miles; and that in a small breeze, the wind moved at the

But it has been observed by Cavallo and others, that this
method is very fallacious, partly because it is not known
whether the clouds do or do not move exactly with the air
in which they float; and partly because the velocity of the
air in the region where the clouds float is by no means the
fame with that of the air which is nearer to the surface of
the earth, and is sometimes quite contrary to it, as indicated
by the motion of the clouds themselves. Others have esti-
mated the velocity of the wind by the changes affected by
it upon the motion of found, which must of course be very
inaccurate. A very simple method of determining the ve-
locity of the wind is that which M. Coulomb (Mem. de
l'Acad. Roy. 1781, p. 70.) employed in his experiments
on wind-mills, because it requires neither the aid of instru-
ments nor the trouble of calculation. Two persons were
placed on a small elevation, at the distance of 150 feet from
one another, in the direction of the wind; and, while the
one observed, the other measured the time which a small
and light feather employed in removing through this space.
The distance between the two persons, divided by the num-
ber of seconds, gave the velocity of the wind per second.
The best method, says Cavallo, of measuring the velocity of
the wind, is by observing the velocity of the smoke of a
low chimney, or by estimating the effect it produces upon
certain bodies, and thus may be determined its force as well
as its velocity. We shall here observe, that from the concurrence
of experiments made with various instruments, and different
modes of calculation, it has been inferred, that in currents of
air, of the denomination which are expre sued in the 4th
column of the annexed table, the air moves at the rate of
so many feet per second as are expressed in the 2d column,
or of so many miles per hour as are expressed in the 1st
column.

A Table of the different velocities and forces of the
winds, constructed by Mr. Roule with great care, from a
considerable number of facts and experiments, and
communicated to Mr. Smeeant, and first published by him in
the 5th volume of the Philosophical Transaotions.

| Miles in one Hour. | Feet in one Second. | Perpendicular Force on one Square Foot, in Air and Atmos- 
| Common Appraisals of the | | Pounds. |
| per Hour. | | |
| 1 | 1.47 | .005 | Hardly perceptible. |
| 2 | 2.93 | .020 | Soft perceptible. |
| 3 | 4.40 | .044 | Gentle pleasant wind. |
| 4 | 5.87 | .079 | Pleasant brisk gale. |
| 5 | 7.33 | .123 | Very brisk. |
| 10 | 14.67 | .492 | High wind. |
| 15 | 22.00 | 1.107 | Very high. |
| 20 | 29.34 | 1.698 | A storm or tempest. |
| 25 | 36.67 | 3.075 | A great storm. |
| 30 | 44.01 | 4.429 | A hurricane. |
| 35 | 51.34 | 6.027 | A hurricane that tears up trees, and carries |
| 40 | 58.68 | 7.873 | buildings, &c. before it. |
| 45 | 66.01 | 9.653 | |
| 50 | 75.35 | 12.300 | |
| 60 | 88.02 | 17.715 | |
| 80 | 117.36 | 31.490 | |
| 100 | 146.70 | 49.200 | |

The force of the wind is as the square of its velocity; as
Mr. Ferguson has shown by experiments on the whirling-
table; and in moderate velocities this will hold very nearly.

On
Upon this principle the numbers in the third column are calculated. The proposition upon which this column has been formed seems to be, that the impulse of a current of air, striking perpendicularly upon a given surface, with a certain velocity, is equal to the weight of a column of air which has that surface for its base, and for its height the space through which a body must fall, in order to acquire that velocity of the air.

It is observed, with regard to this table, that the evidence for those numbers, where the velocity of the wind exceeds fifty miles an hour, does not seem of equal authority with that of those of fifty miles, or under. Phil. Trans. vol. i. p. 165.

Dr. Hales found (Statistical Eff. vol. ii. p. 326.) that the air rushed out of a pair of smith's bellows, at the rate of 68.73 feet in a second of time, when compressed with a force equal to the weight of one inch perpendicular depth of mercury, lying on the whole upper surface of the bellows. The velocity of the air, as it paffed out of the trunk of his ventilators, was found to be at the rate of three thousand feet in a minute; which is at the rate of thirty-four miles an hour. Dr. Hales says, that the velocity with which impelled air paffes out at any orifice may be determined by hanging a light valve over the nose of a bellows, by plant leathern hinges, which will be much agitated and lifted up from a perpendicular to a more than horizontal position by the force of the rushing air. There is another more accurate way, he says, of estimating the velocity of air, viz. by holding the orifice of an inverted glass fiphon full of water, opposite to the stream of air, by which the water will be depressed in one leg, and raised in the other, in proportion to the force with which the air is impelled by the air. Descritp. of Ventilators, 1743, p. 12, &c.

The velocity and force of the wind are determined experimentally by a peculiar machine, called an anemometer or wind-measurer. Of these there have been many, variously constructed. See ANEMOMETER, ANEMOSCOPE, and WIND-CAGES.

WIND, Qualities and Effects of. 1. "A wind blowing from the sea is always moist; in summer, it is cold; and in winter, warm, unless the sea be frozen up." This is demonstrated thus: there is a vapour continually rising out of all water, (as appears even hence, that a quantity of water, being left a little while in an open vessel, is found sensibly diminished,) but especially if it be exposed to the sun's rays; in which case, the evaporation is beyond all expectation. By this means, the air incumbent on the sea becomes impregnated with a quantity of vapour. But the winds, blowing from off the sea, sweep these vapours along with them; and consequently they are always moist. Again, water in summer, &c. conceives less heat than terrestrial bodies, exposed to the same rays of the sun, do; but in winter, sea-water is warmer than the earth covered with frost and snow, &c. Wherefore, as the air contiguous to any body is found to partake of its heat and cold, the air contiguous to sea-water will be warmer in winter, and colder in summer, than that contiguous to the earth. Or thus: vapours raised from water by the sun's warmth in winter, are warmer than the air they rife in, (as appears from the vapours condensing, and becoming visible, almost as soon as they are got out into air.) Fresh quantities of vapour, therefore, continually warming the atmosphere over the sea, will raise its heat beyond that of air over the land. Again, the sun's rays reflected from the earth into the air, in summer, are much more than those from the water into air: the air, therefore, over the earth, warmed by the reflection of more rays than that over water, is warmer. Hence, sea-winds make thick, cloudy, hazy weather.

2. "Winds, blowing from the continent, are always dry; in summer, warm; and cold in winter." For there is much less vapour arising from the earth, than from water; and, therefore, the air over the continent will be impregnated with much fewer vapours. Add, that the vapours, or exhalations, raised by a great degree of heat out of the earth, are much finer, and less sensible, than those from water. The wind, therefore, blowing over the continent, carries but little vapour with it, and is therefore dry.

Farther, the earth in summer is warmer than water exposed to the same rays of the sun. Hence, as the air partakes of the heat of contiguous bodies, that over the earth in summer will be warmer than that over the water: therefore, the winds, &c.

After the like manner it is shewn, that the land-winds are cold in winter. Hence, we fee why land-winds make clear cold weather.

Our northerly and southerly winds, however, which are commonly esteemed the caules of cold and warm weather, Dr. Derham observes, are really rather the effect of the cold or warmth of the atmosphere. Hence it is, that we frequently see a warm southerly wind, on a sudden, changed to the north, by the fall of snow or hail; and that in a cold frosty morning, we see the wind north, which afterwards wheels about toward the southerly quarter, when the sun has well warmed the air; and again, in the cold evening, turns northerly, or eartherly. See Darwin's Observations supra.

For the manner in which north-easterly winds contribute to blights, see BLIGHT. For the effect of winds on the barometer and thermometer, see BAROMETER, &c.

The utility of winds has been universally acknowledged. The ancient Perians, Phoenicians, Greeks, and Romans, sacrificed and erected temples to the winds; as we learn from Voifius, Theolog. Gentil. lib. iii. part i. cap. i. Besides their use in moving bellows, mills and other machines, applied in various ways to the service of mankind, and the benefits resulting from them to navigation and trade, they serve to purify and refresh the air, to convey the heat or cold of one region to another, to produce a regular circulation of vapours from the ocean to countries remote from it, and to supply by wafting them in their progres against hills, &c. springs and rivers.

Wind has been, by many authors, made the basis of many different diseases: among others, Dr. Reyn has given it as his opinion, in a Treatise on the Gout (De Arthritis.), that flatulences, or wind inflowed between the periosteum and the bone, are the true caule of that disea; and accordingly, that all the methods of cure ought to tend to the expelling of that wind.

He is also of opinion, that head-aches, palpitations of the heart, tooth-aches, pleurisy, convulsions, colics, and many other diseases, are originally owing to the same cause, and only differ in regard to the place affected, and to the various motions and determinations of the wind. The moveableflens of the pain in gouty persons from one part to another, he looks on as a proof of this, and thinks that the curing of the gout by burning moxa, or the cotton of the mugwort leaves, upon it, is owing to its giving way to the wind in the part to evaporate itself.

That these winds are cold, appears from the shivering fits which generally precede a paroxysm of the gout; and that the shiverings in the beginning of fevers, and before all fits of agues, are owing to the same cause, is supposed by this
WIND.

The author makes a natural conclusion from the former observations.

Their differences, he says, principally proceed from the various fermentations producing in us a variety of sensations; which acting upon one another, do in their effects produce winds of various effects, and denote different faces from the places which are the foci of their action. It is on this account that the acupuncture, or prickings with long needles, among the Chinee, is of use: the Japanese, and other neighboring nations, having no other cure for most diseases than the prickings with the needle, and the burning of the moxa on the part.

The husbandman often suffers extremely by high winds in many different respects. Plantations of trees, at a small distance from the barns and houses, are the best safeguard against their suffering by winds; but they must not be planted too near as that they fall, if it should happen, would endanger them. Jews grow very slowly, otherwise they are the best of all trees for this defensive plantation. Trees suffer by winds, being either broken or blown down by them; but this may be in a great measure prevented by cutting off great part of the heads and branches of them, in places where they stand most exposed.

Rocks are the most subject to be injured by winds of any crop; but this may be in a great measure prevented by a high pale, or very thick thorn-hedge; this will both keep off the spring wind, which nips the young buds, and be a great safeguard against other winds that would tear the plants from their poles. The poles should always be very firm in the ground; and the best security to be added to this, is a row of tall trees all round the ground.

Winds, attended with rain, do great injury to the corn, by laying it flat to the ground. The best method of preventing this, is to keep up good enclosures; and if the accident happens, the corn should be cut immediately, for it never grows at all afterwards. It should be left on the ground, in this case, some time after the cutting, to harden the grain in the ear. Mortimer's Husbandry, p. 302.

Wind, in Navigation, is the same agitation of the air, considered as serving for the motion of vessels on the water.

If the wind blows gently, it is called a breeze; if it blows harder, it is called a gale, or a stiff gale; and if it blows very hard, it is called a storm.

The following observations on the wind have been made by skilful seamen, and particularly by Dr. Halley.

1. Between the limits of 60°, viz. from 30° of north latitude to 30° of south latitude, there is a constant, or almost constant, easterly wind through the year, blowing in the Atlantic and Pacific oceans, called the trade-wind; which see.

2. The trade-winds, near their northern limits, blow between the north and east; and near their southern limits they blow between the south and east.

The trade-wind seems to depend principally upon the rarefaction of the air, which is occasioned by the heat of the sun progresively from the east towards the west. The air which is rarefied, and, of course, elevated by the heat of the sun immediately over it, is condensed, and descends as soon as the sun is gone over another place to the west of the former; then the air of the latter place is rarified, and the condensed air of the former rushes towards it, &c. From the northern and southern parts of the world, the air likewise runs to the place which is immediately under the sun; but those directions, combining with the easterly wind, which blows nearer to the equator, form the above-mentioned north-easterly and south-easterly winds on the borders of the trade-wind.

3. These general motions of the wind are disturbed on the continents, and near their coasts.

In places that are farther from the equator, the rarefaction which arises from the heat of the sun, and from the attraction of the sun and moon, is less active; and is besides influenced by a variety of local and accidental circumstances, such as extensive continents, mountains, rains, islands, &c. which disturb, interrupt, or totally change the direction of the wind. Hence, in those latitudes north and south, which are beyond the limits of the trade-wind, or near the coasts, the winds are very uncertain; nor has any good theory been as yet formed respecting them.

4. In some parts of the Indian ocean there are periodical winds, which are called Monsoons; which see.

For the explanation of these, it is said, that as the air, which is cool and dense, will force the warm rarefied air in a continual stream upwards, there it must spread itself to preserve the equilibrium. Therefore the upper course or current of air must be contrary to the under current; for the upper air must move from those parts where the greatest heat is; and so, by a kind of circulation, the N.E. trade-wind below will be attended with a S.W. above; and a S.E. below, with a N.W. above.

5. In the Atlantic ocean, near the coasts of Africa, at about a hundred leagues from the shore, between the latitudes of 28° and 10°, feamen cautiously meet with a fresh gale of wind blowing from the N.E.

6. Those bound to the Caribbean islands, across the Atlantic ocean, find, as they approach the American side, that the said N.E. wind becomes calmer; or seldom blows more than a point from the east, either to the northward or southward. These trade-winds, on the American side, are extended to 30°, 31°, or even to 32° of N. latitude; which is about 4° farther than they extend on the African side; also to the southward of the equator, the trade-winds extend three or four degrees farther toward the coast of Brazil, on the American side, than they do near the Cape of Good Hope, on the African side.

7. Between the latitudes of 4° N. and 4° S., the wind always blows between the south and east; on the African side, the winds are nearest the south; and on the American side, nearest the east. In these seas, Dr. Halley observed, that when the wind was easterly, the weather was gloomy, dark, and rainy, with hard gales of wind; but when the wind veered to the southward, the weather generally became serene, with gentle breezes, approaching to a calm. These winds are somewhat changed by the seasons of the year; for when the sun is far northward, the Brazil S.E. wind turns to the south, and the N.E. wind to the east; and when the sun is far south, the S.E. wind gets to the east, and the N.E. winds on this side of the equator veer more to the north.

8. Along the coast of Guinea, from Sierra Leone to the island of St. Thomas, under the equator, which is above five hundred leagues, the southerly and south-westerly winds blow perpetually; for the S.E. trade-wind, having passed the equator, and approaching the Guinea coast within eighty or a hundred leagues, inclines toward the shore, and becomes south, then S.E., and by degrees, as it comes near the land, it veers about to south, S.S.W., and in with the land it is S.W. and sometimes W.S.W. This tract is subject to frequent calms, violent sudden gusts of winds, called tornadoes, blowing from all points of the horizon.

The westerly wind on the coast of Guinea is probably owing
WIND.

owing to the nature and situation of the land, which, being greatly heated by the sun, rarefies the air exceedingly; hence the cooler and heavier air from over the sea will keep rushing in to reful the equilibrium.

9. Between the fourth and tenth degrees of north latitude, and between the longitudes of Cape Verde, and the easternmost of the Cape Verde isles, there is a tract of sea subject to perpetual calms, attended with frequent thunder and lightning, and rains; whence this part of the sea is called ‘The Rains.’ Ships in sailing these four degrees are said to have been sometimes detained whole months.

The cause of this seems to be, that the wetterly winds setting in on this coast, and meeting the general easterly wind in this tract, balance each other, and cause the calms; and the vapour carried thither by the hottest wind, meeting the coolest, is condensed, and occasions the very frequent rains.

The three last observations account for two circumstances which mariners experience in sailing from Europe to India, and in the Guinea trade.

The for is the difficulty which ships, in going to the southward, experience, especially in the months of July and August, in passing between the coast of Guinea and Brazil, although the breadth of this sea is more than five hundred leagues. This happens, because the S.E. winds at that time of the year commonly extend some degrees beyond the ordinary limits of four degrees north latitude; and besides coming to much fether, as to be sometimes fouth, sometimes a point or two to the west; it then only remains to ply to windward; and if, on the one side, they fleer W.S.W. they get a wind more and more easterly; but there is a danger of falling in with the Brazilian coast, or shoals; and if they fleer E.S.E. they fall into the neighbourhood of the coast of Guinea, from whence they cannot depart without running easterly as far as the island of St. Thomas; and this is the constant practice of all the Guinea ships.

Secondly, With regard to all ships departing from Guinea for Europe, their direct course is northward; but on this course they cannot go, because the coast bending nearly east and west the land is to the northward; therefore, as the winds on this coast are generally between the S. and W.S.W., they are obliged to fleer S.S.E. or S., and with these courses they run off the shore; but in so doing they always find the winds more and more contrary; so that when near the shore they can lie fouth, at a greater distance they can make no better than S.E., and afterwards E.S.E.; with which courses they commonly fetch the island of St. Thomas and Cape Lopez, where, finding the winds to the easterly of the fouth, they wait easterly with it, till coming to the latitude of four degrees fouth, they there find the S.E. winds blowing perpetually.

On account of these general winds, all thofe that ufe the West India trade, even thofe bound to Virginia, reckon it their beft course to get as soon as they can to the southward, fo that they may be certain of a fair and free gale to run before it to the westward; and for the fame reafon, thofe homeward-bound from America endeavour to gain the latitude of thirty degrees, where they first find the winds begin to be variable; though the molt ordinary winds in the North American ocean come from between the fouth and weft.

10. Between the southern longitudes of ten and thirty degrees in the Indian ocean, the general trade-wind about the S.E. by S. is found to blow all the year long in the fame manner as in the like latitude in theEthiopian ocean; and during the six months from May to December, thofe winds reach to within two degrees of the equator; but during the other six months, from November to June, a N.W. wind blows in the reft, lying between the third and tenth degrees of southern latitude, in the meridian of the north end of Madagascar; and between the second and twelfth degree of south latitude, near the longitude of Sumatra and Java.

11. In the reft between Sumatra and the African coaft, and from three degrees of south latitude quite northward to the Asiatic coasts, including the Arabian sea and the gulf of Bengal, the monfouns blow from September to April on the N.E., and from March to October on the S.W. In the former half the year the wind is more freftly and gentle, and the weather clearer than in the latter six months; and the wind is more freftly and steady in the Arabian sea than in the gulf of Bengal.

12. Between the island of Madagascar and the coaft of Africa, and thence northward as far as the equator, there is a reft, in which, from April to October, there is a conftant fresh S.S.W. wind; which to the northward changes into the W.S.W. wind, blowing at that time in the Arabian sea.

13. To the easterly of Sumatra and Malacca on the north of the equator, and along the coasts of Camboya and China, quite through the Philipinas as far as Japan, the monfoons blow north ery and fouthery; the northern setting in about October or November, and the southern about May; thofe winds are not quite fo certain as thofe in the Arabian seas.

14. Between Sumatra and Java to the weft, and New Guinea to the eaf, the fame northery and fouthery winds are obferved; but the firft half-year monfouns inclines to the N.W., and the latter to the S.E. Thofe winds begin a month or fix weeks after thofe in the Chinefe seas let in, and are quite as variable.

15. Thofe contrary winds do not shift from one point to its opposite all at once; in fome places, the time of the change is attended with calms; in others, by variable winds; and it often happens on the fhores of Coromandel and China, towards the end of the monfouns, that there are molt violent ftrorms, greatly rehmbeling the hurricanes in the Weft Indies; in which the wind is fo very ftrong, that hardly any thing can refund its force.

All navigation in the Indian ocean muft necofarly be regulated by these winds; for if mariners fhould delay their voyages till the contrary monfoun begins, they muft either fail back, or go into harbour, and wait for the return of the trade-wind.

16. The irregularities of the wind in countries which are farther from the equator than thofe which have been men- tioned above, or nearer to the poles of the earth, are fo great that no particular period has as yet been discovered, excepting that in particular places certain winds are more likely to blow than others. Thus at Liverpool the winds are said to be wefterly for near two-thirds of the year; in the fouthern part of Italy, a north-eaft wind (called the fibriacco) blows more frequently than any other wind, &c.

17. The temperature of a country with refpeft to heat or cold is increafed or diminished by winds, according as they come from a hotter or colder part of the world. The north and north-eaftly winds, in this country and all the western parts of Europe, are reckoned cold and drying winds. They are cold, because they come from the frozen region of the north pole, or over a great tract of cold land. Their drying quality is derived from their coming principally over land, and from a well-known property of the air; namely, that warm air can difsolve, and keep diffolved, a greater
greater quantity of water than colder air: hence the air which comes from colder regions, being heated over warmer countries, becomes a better solvent of moisture, and dries up with greater energy the moist bodies it comes in contact with; and, on the other hand, warm air coming into a colder region deposits a quantity of the water it kept in solution, and occasions mists, fogs, clouds, rains, &c. "In short," says colonel Roy, "the winds seem to be drier, denser, and colder, in proportion to the extent of land they pass over from the poles towards the equator; but they appear to be more moist, warm, and light, in proportion to the extent of ocean they pass over from the equator towards the poles. Hence the humidity, warmth, and lightness, of the Atlantic winds to the inhabitants of Europe. On the east coasts of North America the severity of the N.W. wind is universally remarked; and there can scarcely be a doubt, that the inhabitants of California, and other parts on the west side of that great continent, will, like those on the west of Europe, feel the strong effects of a N.E. wind."

18. In warm countries, sometimes the winds, which blow over a great tract of highly-heated land, become so very drying, scorching, and suffocating, as to produce dreadful effects. These winds, under the names of Blooms, Samiel, and Solano, are often felt in the deserts of Arabia, in the neighbourhood of the Persian gulf, in the interior of Africa, and in some other places. There are likewise in India, part of China, part of Africa, and elsewhere, other winds, which deposit so much warm moisture as to soften, and actually to diffuse glue, salts, and almost every article which is soluble in water.

19. It is impossible to give any adequate account of irregular winds, especially of those sudden and violent gales as come on at very irregular periods, and generally continue for a short time. They sometimes spread over an extensive tract of country, and at other times are confined within a remarkably narrow space. Their causes are by no means rightly understood, though they have been vaguely attributed to peculiar rarefactions, to the combined attractions of the sun and moon, to earthquakes, to electricity, &c. They are called in general hurricanes, or they are the principal phenomenon of a hurricane, that is, of a violent storm. Almost every one of those violent winds is attended with particular phenomena, such as droughts, or heavy rains, or hail, or snow, or thunder and lightning, or several of those phenomena at once. They frequently visit suddenly from one quarter of the horizon to another, and then come again to the former point. In this case they are called tornades.

In mountainous countries, the wind sometimes rages with extreme violence, and the mountains generally exhibit signs of the approaching storm. Thus, at the Cape of Good Hope, there are four remarkable mountains, called Table Land, or Mountain; Sugar-Leaf, or the Lion's Head; James Mount, or the Lion's Rump; and Charles Mount, called also the Devil's Tower, or Devil's Head, from the violent squalls of wind which come from it. In the summer season Table Mountain is sometimes suddenly covered with a white cloud, called the Table-cloth; when this cloud seems to roll down the steep face of the mountain, it is a sure indication of an approaching gale of wind from the S.E., which generally blows with great violence, and sometimes continues a day or more, but in common is of short duration. On the first appearance of this cloud, the ships in Table bay begin to prepare for it, by striking yards and top-masts, and making everything as snug as possible. If, in the morning, the cloud extends from the Table to Mount Charles, or the Devil's Tower, which are almost contiguous, it is a general saying among seamen, that the old gentleman is going to breakfast; if in the middle of the day, that he is going to dinner; and if in the evening, that the cloth is spread for supper.

There are various other periodical winds; of these, however, that generally known by the name of Limbat, which is common in the island of Cyprus, shall only be mentioned here. The period of this wind is five days: on the first day, it begins to blow at eight in the morning, and increases till noon; from thence it gradually weakens, and ceases entirely about three P.M. On the second day, it arises at the same hour; but it does not attain its greatest strength till about one in the afternoon, and ceases at four. On the third day, it begins as before; but it falls an hour later. On the remaining days, it follows the same progression as on the third; but it is remarked, that a little before it ceases, it becomes extremely violent. Upon the N.W. side of the above island, this wind is considered as a sea-breeze; and upon the S.E. as a land-breeze. See Wind, Qualities of, supra. See also Hurricanes, Tornadoes, and Whirl-Wind. See Phil. Trans. N° 183, or Abr. vol. ii. p. 133, &c. Robertson's Elem. of Nav. b. vi. f. 6. Cavallo's Philos. vol. ii.

The winds are divided, with respect to the points of the horizon from which they blow, into cardinal and collateral.

Winds, Cardinal, are those blowing from the four cardinal points; east, west, north, and south.

Thus, a wind that blows from the E. towards the W. is called east wind; when it blows from the W. towards the E., west wind; when it blows from the N. to the S., it is called north wind; and when it blows from the S. towards the N., it is called south wind.

Winds, Collateral, are the intermediate winds between any two cardinal winds. The number of these is infinite, as the points from which they blow are; but only a few of them are considered in practice; i.e. only a few of them have their distinguishing names.

Those winds which deviate a little from the cardinal points are called northerly, easterly, southerly, and westerly winds. But for the sake of greater dilution, the space or arch which lies between any two contiguous cardinal points, is supposed, by the mariners, to be divided into eight equal parts, or points, and each point into four equal parts, called quarter-points. So that the horizon is supposed to be divided into thirty-two principal points, which are called rhumbs, or winds, to each of which a particular name is assigned; and those names are derived from the names of the adjacent cardinal points. See Compass.

The ancient Greeks, at first, only used the four cardinal ones; at length they took in four more. Vitruvius gives us a table of twenty, besides the cardinals, which were in use among the Romans.

The moderns, as their navigation is much more perfect than that of the ancients, have given names to twenty-eight collateral winds, which they range into primary and secondary; and the secondary they subdivide into those of the first and second order.

The English names of the primary collateral winds and points are compounded of the names of the cardinal ones, north and south being still prefixed.

The names of the secondary collateral winds of the first order are compounded of the names of the cardinals, and the adjacent primary one. Those of the second order are compounded of the names of the cardinal, or the next adjacent primary; and the next cardinal, with the addition of the word by. The Latins have distinct names for each; all which are expressed in the following Table.
Names of the Winds and Points of the Compass.

<table>
<thead>
<tr>
<th>English</th>
<th>Latin and Greek</th>
</tr>
</thead>
<tbody>
<tr>
<td>North.</td>
<td>Septentrio, or Boreas.</td>
</tr>
<tr>
<td></td>
<td>Hyperboreas.</td>
</tr>
<tr>
<td></td>
<td>Hyperaquilo.</td>
</tr>
<tr>
<td></td>
<td>Gallicus.</td>
</tr>
<tr>
<td>North by east.</td>
<td>Aquilo.</td>
</tr>
<tr>
<td>North-north-east.</td>
<td>Mefoboreas.</td>
</tr>
<tr>
<td>North-east by north.</td>
<td>Mefaquilo.</td>
</tr>
<tr>
<td>North-east.</td>
<td>Archaepelites.</td>
</tr>
<tr>
<td>North-east by east.</td>
<td>Graeus.</td>
</tr>
<tr>
<td>East.</td>
<td>Hypocorbas.</td>
</tr>
<tr>
<td>East by north.</td>
<td>Cebias, Hellespontius.</td>
</tr>
<tr>
<td>East-north-east.</td>
<td>Mefocorbas.</td>
</tr>
<tr>
<td>East by south.</td>
<td>Zephyrus, favonius.</td>
</tr>
<tr>
<td>East by west.</td>
<td>Hypercaflus.</td>
</tr>
<tr>
<td>East by south.</td>
<td>Aquedens.</td>
</tr>
<tr>
<td>East by north.</td>
<td>Hypargenetes.</td>
</tr>
<tr>
<td>East by west.</td>
<td>Hypocorbas.</td>
</tr>
<tr>
<td>South.</td>
<td>Notapeliotes.</td>
</tr>
<tr>
<td>South by east.</td>
<td>Zephyro-boreas.</td>
</tr>
<tr>
<td>South by south.</td>
<td>Libycus, olympias.</td>
</tr>
<tr>
<td>South-west by south.</td>
<td>Hypocorbas.</td>
</tr>
<tr>
<td>South-west.</td>
<td>Hypothraeias.</td>
</tr>
<tr>
<td>South-west by west.</td>
<td>Scirem.</td>
</tr>
<tr>
<td>South-west by south.</td>
<td>Circius, thracentias.</td>
</tr>
<tr>
<td>South-west by east.</td>
<td>Mefolibs.</td>
</tr>
</tbody>
</table>

Names of the Winds.

<table>
<thead>
<tr>
<th>English</th>
<th>Distance from North</th>
</tr>
</thead>
<tbody>
<tr>
<td>Septentrio.</td>
<td>0° 0'</td>
</tr>
<tr>
<td>Gallicus.</td>
<td>15</td>
</tr>
<tr>
<td>Supernas.</td>
<td>30</td>
</tr>
<tr>
<td>Aquilo.</td>
<td>45</td>
</tr>
<tr>
<td>Mefoborbas.</td>
<td>60</td>
</tr>
<tr>
<td>Mefoboreas.</td>
<td>75</td>
</tr>
<tr>
<td>Mefocorbas.</td>
<td>75</td>
</tr>
<tr>
<td>Zephyrus, favonius.</td>
<td>0° 0'</td>
</tr>
<tr>
<td>Hypercaflus.</td>
<td>15</td>
</tr>
<tr>
<td>Hypocorbas.</td>
<td>30</td>
</tr>
<tr>
<td>Caurus, corus, iapyx.</td>
<td>45</td>
</tr>
<tr>
<td>Mefocorbas.</td>
<td>60</td>
</tr>
<tr>
<td>Zephyro-boreas, borolibycus, olympias.</td>
<td>75</td>
</tr>
<tr>
<td>Hypocorbas.</td>
<td>0° 0'</td>
</tr>
<tr>
<td>Aquedens.</td>
<td>15</td>
</tr>
<tr>
<td>Caurus, corus, iapyx.</td>
<td>30</td>
</tr>
<tr>
<td>Mefocorbas.</td>
<td>45</td>
</tr>
<tr>
<td>Zephyro-boreas, borolibycus, olympias.</td>
<td>60</td>
</tr>
<tr>
<td>Hypocorbas.</td>
<td>15</td>
</tr>
<tr>
<td>Aquedens.</td>
<td>30</td>
</tr>
<tr>
<td>Caurus, corus, iapyx.</td>
<td>45</td>
</tr>
<tr>
<td>Zephyro-boreas, borolibycus, olympias.</td>
<td>60</td>
</tr>
<tr>
<td>Hypocorbas.</td>
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<td>Aquedens.</td>
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<tr>
<td>Caurus, corus, iapyx.</td>
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<tr>
<td>Zephyro-boreas, borolibycus, olympias.</td>
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</tr>
<tr>
<td>Hypocorbas.</td>
<td>15</td>
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<tr>
<td>Aquedens.</td>
<td>30</td>
</tr>
<tr>
<td>Caurus, corus, iapyx.</td>
<td>45</td>
</tr>
<tr>
<td>Zephyro-boreas, borolibycus, olympias.</td>
<td>60</td>
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<tr>
<td>Hypocorbas.</td>
<td>15</td>
</tr>
<tr>
<td>Aquedens.</td>
<td>30</td>
</tr>
<tr>
<td>Caurus, corus, iapyx.</td>
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</tr>
<tr>
<td>Zephyro-boreas, borolibycus, olympias.</td>
<td>60</td>
</tr>
</tbody>
</table>

Note.—The ancient names are here, after Ricciolus, adapted to the modern ones; not that the winds formerly denoted by those were precisely the same with these, (for the ancient number and division being different from the modern, the points they refer to will necessarily be somewhat different,) but these are what come the nearest. Thus, Vitruvius, only reckoning twenty-four winds, disposes the points they refer to in a different order; as in the following Table.
WIND.

The following Table shews the angles which every rhumb or point of the compass makes with the meridian; by means of which the direction of the wind, &c. may be determined.

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>N. by E.</td>
<td>S. by E.</td>
<td>1/4</td>
<td>2</td>
<td>49</td>
<td>N. by W.</td>
<td>S. by W.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1/2</td>
<td>5</td>
<td>37 1/2</td>
<td></td>
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<td></td>
<td></td>
<td>1/4</td>
<td>8</td>
<td>26</td>
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<td>4</td>
<td>N.N.W.</td>
<td>S.S.W.</td>
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<td>1</td>
<td>16</td>
<td>52 1/2</td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1/2</td>
<td>19</td>
<td>41</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>22</td>
<td>30</td>
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<td></td>
</tr>
<tr>
<td>N.E. by N.</td>
<td>S.E. by S.</td>
<td>2 1/4</td>
<td>25</td>
<td>19</td>
<td>N.W. by N.</td>
<td>S.W. by S.</td>
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<tr>
<td></td>
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<td>7 1/2</td>
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<td></td>
<td>3</td>
<td>33</td>
<td>45</td>
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<tr>
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<td>34</td>
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<td>S.W.</td>
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<tr>
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<td>39</td>
<td>22 1/2</td>
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<td>S.E. by E.</td>
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<td>S.W. by W.</td>
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<td>67</td>
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<tr>
<td>E. by N.</td>
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<td>W. by S.</td>
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<tr>
<td></td>
<td></td>
<td>4 1/2</td>
<td>73</td>
<td>7 1/2</td>
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<tr>
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<td>5 1/4</td>
<td>75</td>
<td>56</td>
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<td></td>
<td>6</td>
<td>78</td>
<td>45</td>
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<tr>
<td>East.</td>
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<td>5 1/4</td>
<td>81</td>
<td>34</td>
<td>West.</td>
<td>West.</td>
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<tr>
<td></td>
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<td>5 1/2</td>
<td>84</td>
<td>22 1/2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>6 1/2</td>
<td>87</td>
<td>11</td>
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<td>7</td>
<td>90</td>
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</table>

For the use of the winds in navigation, &c. see Sailing.

WIND, a disease in sheep of a very dangerous and distressing kind.

It is observed in the Shepherd's Guide, that in this complaint, the sheep, immediately after being clipped or shorn, appear to be in violent pain, their sides are somewhat extended, and their breathing very short, the head is hung down drooping, and they have a great aversion to moving or walking. These symptoms continue to increase until the sheep dies, which is in a very few hours, unless a violent purging comes on, which generally gives immediate relief. On inquiring for the name of this affection, the writer says, he found it was called the wind, but where the seat of it lay few could tell him; some thought it was in the head, others in the lungs; and the remedies they applied were as various as their opinions of the nature of the disease.

Not being satisfied with these accounts, he endeavoured, by inspecting the carcasses of sheep that died of the disease, to discover the cause and seat of the complaint. On opening four sheep that died of the disease, he found all the intestines rather distended with flatus, but not in any great degree. Their blood-vessels were very turgid, and of a deep red, particularly those of the large intestines, excepting the rectum, or what is called the bum-gut, which had a healthy appearance, as likewise had the stomach, small intestines, liver, heart, lungs, and in short all the viscera contained in the cavity of the trunk. From these appearances he ventures to say, that the disease in question is a violent inflammation of the intestines, perhaps in some measure arising from bruises in shearing, but more from losing a warm clothing, and being suddenly exposed to cold air and cold feeding.

He therefore recommends to farmers, that on the first appearance of the complaint they put the sheep into a flake or other warm place, and immediately bleed it freely. Then to bruise a quarter of an ounce of some carminative seed, such as cumin, anise, cummin, or fennel, and to mix thele with two ounces of Glauber's purging salts, in a pint of water, placing it on a fire, and making it boil for a few minutes, then to strain it off. Then to add a quarter of an ounce
ounce of powdered jalap, and while lukewarm to give the sheep a quarter of a pint of this liquor, well shaken together, every half hour till it dung. It should have no food or cold water until recovered, but a little warm water might be of service in some cases.

This is a disorder which is in general so suddenly fatal, that recours should be instantly had to any remedy that may have been found beneficial; but bleeding is probably that on which the greatest dependence may be placed, with calomel in some infirmities.

Wind, among Animals, is another name for the breath, or rather for the power with which the lungs are endowed in the exercise of their functions, which in many cases is a sort of morbid affection of them, especially in horfes, swine, calves, and some others. Horses are often thick-winded and purvey, which is this flate, and require much exercife and management, and the other two are sometimes affected in much the same way.

Wind, in Rural Economy, a term applied to a winch or wince in some places.

Wind. Freh. See FRESH.

Wind, To haul the. See HAUL.

Wind, Large, in the Sea Language. See LARGE.

Wind, Quarter, at Sea. See QUARTER.

Winds Reigning. See REIGNING.

Winds, Tropic. See TRADE- WINDS, and WIND FUPRA.

Wind, Side, at Sea, that which blows on the side of the ship.

To Wind a Ship or Boat, in Sea Language, is to change her position, by bringing the stern to lie in the situation of the head, or directly opposite to its former situation.

Wind, in the Mange. A horfe that carries in the wind, is one that toffies his nose as high as his ears, and does not carry handomely.

The difference between carrying in the wind and beating upon the hand is, that a horfe who beats upon the hand shakes his head, and refills the bridge; but he who carries in the wind, puts up his head without faking, and only sometimes beats upon the hand. The oppofite to carrying in the wind is arming and carrying low.

Wind, Whirl. See WHIRL-WIND.

Wind, Coll. See COLIC.

Wind-Droffen. See TYPANITIES.

Wind-Eggs. An addle egg, or an egg that has taken wind. See EGG.

Wind-Fall denotes fruit blown off the tree by the wind.

Wind-Flower, in Botany. See ANEMONE.

Wind-Furnace. See FURNACE.

Wind-Gage, in Pneumatics, an instrument serving to determine the velocity and force of the wind. See ANEMOMETER, ANEMOSCOPE, and Laws of the Force, &c. of the Wind fupra.

Dr. Lind, of Edinburgh, has contrived an apparatus of this kind, which is fimple and easy of conftruction, and which feems to be well adapted for measuring the force of the wind with a fufficient degree of accuracy. This instrument confifts of two glafs tubes A, B, C, D, (Plate XV. Pneumatics, fig. 9.) five or fix inches in length, and about four-tenths of an inch in bore; which are connected together like a fiphon, by a small bent glafs tube a, the bore of which is one-tenth of an inch in diameter. On the uppe: end of the leg A B there is a tube of latten brafs, which is kneet or bent perpendicularly outwards, and has its mouth open towards F; on the other leg C D is a cover, with a round hole G in the upper part of it, two-tenths of an inch in diameter. This cover and the kneet tube are connected together by a flip of brafs, e d, which ftrengthen the whole instrument, and ferves to hold the scale H I. The kneet tube and cover are fixed on with hard cement, or felling-wax. To the fame tube is foldered a piece of brafs, e, with a round hole in it, to receive the fheel fpindle K L, and at f another fuch piece of brafs is foldered to the brafs hoop g b, which furronds both legs of the instrument. There is a small shoulder on the fpindle at f, upon which the instrument reffes, and a small nut i, to prevent it from being blown off the fpindle by the wind. The whole instrument is easily turned round upon the fpindle by the wind, fo as to prevent the mouth of the kneet tube toward it. At the end of the fpindle there is a fcrew, by which it may be fwered to the top of a pole or fland; it has also a hole at L, to admit a fmal lever for frewing it into wood with greater facility. A thin plate of brafs k is foldered on the kneet tube, about half an inch above the round hole G, fo as to prevent rain from falling into it. There is also a crooked tube A B (fig. 10.), to be put occasionally upon the mouth of the kneet tube F, in order to prevent rain from being blown into the mouth of the wind-gage, when it is left exposed to the rain.

This instrument ferves to afsertain the force of the wind, by filling the tube half full of water, and pushing the scale a little up or down, till 0 upon the scale, when the instrument is held perpendicularly, be on a line with the furface of the water, in both legs of the wind-gage. The instrument being thus adjufled, hold it up perpendicularly, and turning the mouth of the kneet tube toward the wind, obferv how much the water is defreffed by it in one leg, and how much it is raised in the other. The fun of the two is the height of a column of water, which the wind is capable of difpofing at that time; and every body that is oppofed to that wind, will be preffed upon by a force equal to the weight of a column of water, having its base equal to the furface that is oppofed, and its height equal to the altitude of the column of water defpofed by the wind in the wind-gage. Hence the force of the wind upon any body, where the furface oppofed to it is known, may be easily found; and a ready comparifion may be made betwixt the strength of one gale of wind, and that of another, by knowing the heights of the columns of water which the different winds were capable of difpofing. The heights of the column in each leg will be equal, provided that the legs are of equal bores; but unequal if their bores are unequal. For fuppose the legs equal, and the column of water defpofed by the wind to be three inches, the water in the leg which the wind blows into will be defpofed 1 ½ inch below 0, and rafed as much in the other leg. But if the bore of the leg which the wind blows into be double that of the other, the water in that leg will be defpofed only one inch, while it is rafed twice as much, or two inches, in the other, and vice verfa.

The force of the wind may likewife be meafured with this instrument, by filling it till the water runs out at G. For if it be then held up to the wind as before, a quanitity of water will be thrown out; and if both legs of the instrument are of the fame bore, the height of the column defpofed will be equal to double the column of water in either leg, or the fun of what is wanting in both legs. But if the legs are of unequal bores, none of these will give the true height of the column of water which the wind defpofed. For, obtaining in this cafe the true height, Dr. Lind has fubjoined the requisite formule. The use of the small tube of communication a b (fig. 9.), is to check the undulation of the water, fo that the height of it may be read off from the scale with ease and certainty; and also to prevent the water
water from being thrown up to a much greater or less altitude than the true height of the column which the wind is able at that time to sustain. The author has calculated a table, by means of which, having the height of the column of water sustained in the wind-gage, the force of the wind upon a foot square may be determined.

<table>
<thead>
<tr>
<th>Height of the Water in the Gage</th>
<th>Force of the Wind on One Foot Square in Pounds Avoidups.</th>
<th>Common Designations of such Winds</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>62.500</td>
<td>Most violent hurricane.</td>
</tr>
<tr>
<td>11</td>
<td>57.293</td>
<td>Very great hurricane.</td>
</tr>
<tr>
<td>10</td>
<td>52.083</td>
<td>Great hurricane.</td>
</tr>
<tr>
<td>9</td>
<td>46.875</td>
<td>Hurricane.</td>
</tr>
<tr>
<td>8</td>
<td>41.667</td>
<td>Very great form.</td>
</tr>
<tr>
<td>7</td>
<td>36.548</td>
<td>Great form.</td>
</tr>
<tr>
<td>6</td>
<td>31.750</td>
<td>Storm.</td>
</tr>
<tr>
<td>5</td>
<td>26.041</td>
<td>High wind.</td>
</tr>
<tr>
<td>4</td>
<td>20.833</td>
<td>Briol gale.</td>
</tr>
<tr>
<td>0.5</td>
<td>2.604</td>
<td>Fresh breeze.</td>
</tr>
<tr>
<td>0.1</td>
<td>0.521</td>
<td>Pleasant wind.</td>
</tr>
<tr>
<td>0.025</td>
<td>0.030</td>
<td>A gentle wind.</td>
</tr>
</tbody>
</table>

When the height of the water is not exactly mentioned in the table, then that height may be separated into such parts as are mentioned in the table, and the sum of the forces answering to such parts will be the force of the wind correspondent to the height in question: thus, if the height of the water be 4.6 inches; then this height is equal to 4 + 0.5 + 0.1, which parts are all in the table; therefore,

<table>
<thead>
<tr>
<th>Inches</th>
<th>Pounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>20.833</td>
</tr>
<tr>
<td>0.5</td>
<td>2.604</td>
</tr>
<tr>
<td>0.1</td>
<td>0.521</td>
</tr>
</tbody>
</table>

The sum is 23.958, which expresses the force of the wind when the height of the water in the gage is 4.6 inches.

Any alteration that can usually take place in the temperature of the water, makes no sensible difference in this instrument.

In frothy weather this gage cannot be used with common water. At that time some other liquor must be used, which is not so subject to freeze; and, upon the whole, a saturated solution of common salt in water is the most eligible: but in that case, (since the specific gravity of a saturated solution of salt is to that of pure water, as 1.244 to 1,) the forces which are stated in the preceding table must be multiplied by 1.244. Thus, if in the preceding example the saturated solution of salt had been used instead of water only, the force of the wind on a square foot would have been 29.8 pounds.

When salt-water is used, the force of the wind, which is stated in the table, must be increased in the proportion of the specific gravity of salt-water to that of common water; thus, using the preceding example, we must lay, as 1 : 1.244 : : 23.958 to a fourth proportional, which must be found by multiplying the second term by the third, and then dividing the product by the first term; but, the first term being unity, we need only multiply 23.958 by 1.244.

On the 9th of May, 1775, Dr. Lind observed, that the wind supported a column of water in his wind-gage 6,570 inches in height; and from his table it appeared, that the force of the wind in this hurricane, which did great damage to the gardens in his neighbourhood, was equal to 34,921 pounds avoidups, on every square foot.

If the velocity and density of the wind in any particular case were accurately determined, this instrument, which gives its force or momentum, would enable us to ascertain the velocity in every other case, the density being known: for the force of the wind is as the square of its velocity. Phil. Trans. vol. lv. part ii. art. 34 p. 353, &c.

Mr. Martin, from a hint first suggested by Dr. Burton, contrived an anemoscope, or wind-gage, of the following construction. A B C D E F G H I (fig. 11.) is an open frame of wood, firmly supported by the shaft or pollern I. In the two cross pieces H, K, L, M, is moved an horizontal axis Q M, by means of the four stays a, b, c, d, e, f, g, h, in a proper manner, exposed to the wind. Upon this axis is fixed a cone of wood M N O, upon which, when the shaft moves round, a weight S is raised by a string on its superficies, proceeding from the small to the largest end N O. Upon the great end or base of the cone is fixed a ratchet-wheel i k, in whose teeth falls the click X, to prevent any retrograde motion from the depending weight.

From the structure of this machine, it is easy to understand, that it may be accommodated to estimate the variable force of the wind, because the force of the weight will continually increase, as the string advances on the conical surface, by acting at a greater distance from the axis. And, therefore, if such a weight be put on, on the smallest part of M, as will just keep the machine in equilibrio with the weakest wind; then as the wind becomes stronger, the weight will be raised in proportion, and the diameter of the base of the cone may be increased in comparison of that of the smaller end or axis at M, that the strongest wind shall but just raise the weight to the great end.

Thus, for example, let the diameter of the axis be to that of the base of the cone N O as 1 to 28; then if s be a weight of one pound on M, on the axis, it will be equivalent to twenty-eight pounds, or 1/5 of an hundred, when raised to the greatest end. If, therefore, when the wind is weakest, it supports one pound on the axis, it must be twenty-eight times as strong to raise the weight to the base of the cone. Thus may a line or scale of twenty-eight equal parts be drawn on the side of the cone, and the strength of the wind will be indicated by that number therein from which the string shall at any time hang.

Furthermore, the string may be of such a size, and the cone of such a length, that there shall be fourteen revolutions of the string between each division of the scale on the cone; so will the strength of the wind be expressed in pounds and ounces. And if greater exactness be required, let the periphery of the cone’s base be divided into fourteen equal parts; then whenever the equilibrium happens, the string will leave the conical surface against one of those divisions, and thus shew the force of the wind to a drachm avoidups weight. Martin’s Phil. Brit. vol. ii. p. 211, &c.

M. Bouger contrived a very simple instrument, by means of which we may immediately discover the force which the wind exerts upon a given surface. This is a hollow tube A B B A (fig. 12.), in which a spiral string C D is fixed, that may be more or less compressed by a rod F S D, passing...
pafting through a hole within the tube at AA; then having observed to what degree different forces or given weights are capable of compri{ing the spiral, mark divi{ions on the rod in such a manner, that the mark at S may indicate the weight requisite to force the spring into the situation CD; afterwards join at right angles to this rod at F, a plane surface E F E of a given area, either greater or less, at pleasure; then let this instrument be opposed to the wind, so that it may strike the surface in the directions V E, V E, parallel to that of the rod, and the mark at S will shew the weight to which the force of the wind is equivalent.

The ingenious professor Leslie (Enquiry into the Nature and Propagation of Heat) having found, in the course of his experiments on heat, that the refrigerating, or cooling power of a current of air, is exactly proportional to its velocity, derives from this principle the construction of a new and simple anemometer. "It is in reality nothing more," says he, "than a thermometer, only with its bulb larger than usual. Holding it in the open still air, the temperature is marked: it is then warmed by the application of the hand, and the time is noted which it takes to sink back to the middle point. This shall term the fundamental measure of cooling. The same observation is made on exposing the bulb to the impression of the wind, and shall call the time required for the bisection of the interval of temperatures, the occasional measure of cooling. After these preliminaries, we have the following easy rule: Divide the fundamental by the occasional measure of cooling, and the excess of the quotient above unit, being multiplied by \( \sqrt{\frac{\text{distance}}{\text{velocity}}} \), will express the velocity of the wind in miles per hour. The bulb of the thermometer ought to be more than half an inch in diameter, and may, for the sake of portability, be filled with alcohol, tinct, as usual, with archil. To simplify the observation, a sliding scale of equal parts may be applied to the tube. When the bulb has acquired the due temperature, the zero of the slide is set opposite to the limit of the coloured liquor in the limb; and after having been heated, it again flands at \( 2^\circ \) in its defcent, the time which then ceases takes until it sinks to \( 1^\circ \) is measured by a stop-watch. Extemporaneous calculation may be avoided, by having a table engraved upon the scale for the series of occasional intervals of cooling."

Wind-Gall, a disease in horses and some other animals. It is a puffy kind of swelling or tumour, which yields to the pressure of the finger, but upon removing the pressure recovers itself, and pushes out as before. These swellings have been thus named from a false notion of their containing nothing but air or wind. These tumours are often seated on both sides of the back of a horse above the fetlock on the fore-legs, but mostly frequently on the hind-legs. They are quite loose and detached from the parts on which they grow, and exhibit the same signs wherever they are met with, whether in the hooves or about the knees; for these swellings are not confined to the lower limbs only, but appear in any of those parts of a horse's body where the cellular membrane can be easily separated; and they exist, for the most part, without occasioning any pain. They are usually caused by riding on very hard roads, or on dry billy grounds. Sometimes travelling horses, when they are worked too young, before its limbs are grown firm and vigorous, will have them. And Gibbon observes, that they sometimes proceed from constitutional weaknesses, especially in bulky horses, that are somewhat under-limbed and hefty about the fetlock-joint. These, it is said, have been known to have wind-galls without any strain, hard riding, or other ill usage of any kind.

It has been observed too, that when these tumours appear upon the hind-legs they never cause lameness, though such horses are often stiff behind after riding. When on the fore-legs they always make a horse go lame at first; but afterwards their lameness goes off in a great measure, and they seldom go lame, but stiff, and inclined to stumble. They generally recover, however, with a day or two. Those flatulent swellings indeed that come in the ligaments of the hocks are always troublesome, disfigure the animal, and, unless speedily affixed, will cause incurable lameness. At first they are but small, but in time they grow to the size of a pullet's egg, perhaps, and push out on each side of the hollow of the hock. Swellings of the same kind also appear before the knee, where they often precede a diseased joint. Very small similar swellings under the fore part of the knee, in the interstices of both sides of the joint, are also dangerous; but these seldom happen, and are usually caused by some violent strain, especially when a horse falls down upon a leant with his whole weight upon his knees. The other flatulent swellings which horses are subject to seldom cause lameness, but are, for the most part, easily cured. We mean those that arise in the interstices of the large muscles of the hips and thighs, which are distended like little bladders filled with air. These come by strains and over-exertion; for draught-horses are the most subject to them.

Wind-galls that proceed from mere weaknesses are seldom curable, unless the constitution can be improved; but we often see horses that were subject to wind-galls when young, get the better of them as they advance in age. The methods of cure in these cases is by means of blistersing, firing, and the use of astringent applications.

As there are enlargements of the capvules, or horse-surface, situated between the tendons, that contain an oily lubricating fluid for the prevention of friction and to facilitate motion, arising from long exertion producing inflammation of them, and an increased secretion of the contained fluid, they are capable of being easily removed in their beginning stages, by reft and the use of blisters to the parts composed of cantharides and corrosive sublimate with olive oil; afterwards turning the animals out to graze or the straw-yard. Or where this cannot be permitted, the parts may be strengthened by the use of a flannel roller, made and continued wet by a wash composed of equal parts of strong vinegar and Goulard water, or the latter alone in some cases. If, however, the disease may have been neglected, recourse must be had to the hot iron; after which the blistersing should be practiced as before advised.

Wind-Gun. See Air-Gun.

Wind-Hatch, in Mining, a term used to express the place at which the ore is taken out of the mines.

The word hatch is the general term used by the miners to express an opening from the surface into the mine, or in the attempting to find a mine.

Thus the word effay-batches signifies the openings made in search of the veins of such veins; and the tin-batch in Cornwall is the name of the opening by which they descend into a tin-mine.

The word wind-batch seems to be a corruption of winder-hatch; for at these places they have a winder conveying two buckets, the one continually up, the other constantly down; the man below fills the bucket that descends; and when that which ascends is emptied at the mouth of the hatch, the person who has the care of that part of the work, delivers it empty to go down again. Phil. Trans. No 09.

Wind-Hover, in Ornithology, the name of a species of hawk,
WIND-MILL.

A windmill, called also by some the flannel, but more usually the kestrel, and known among authors by the names of the tinunculus and cencerit.

WIND-Instruments, in Music, are instruments played by wind, chiefly by the breath; in contradistinction to stringed-instruments, and instruments of the pulsative kind.

The wind-instruments known to the ancients were, the tibia, fluitula, or syrinx of Pan, consisting of seven reeds, joined to a reed pipe; also organ, tubes, cornus, and the litus. Those of the moderns are, the flute, bagpipe, hautboy, trumpet, &c. See Instrument, and Music.

WIND-Mill, in Mechanics, a machine which is put in motion by the force of the wind. Wind-mills are in general applied to the purpose of grinding corn, but are occasionally used to give motion to machines for raising water, sawing-mills, or for other purposes. We shall in this article consider the wind-mill as a first mover, or primus mobile, which may be applied to many purposes.

The invention of wind-mills is not of very remote date. According to some authors they were first used in France in the sixth century; while others maintain that they were brought to Europe in the time of the crusades, and that they had long been employed in the East, where the scarcity of water precluded the application of that powerful agent to machinery.

The wind-mill, though a common machine, has some things in it more ingenious than is usually imagined. Add, that it is commonly allowed to have a degree of perfection, which few of the popular engines have attained to, and which the makers are but little aware of; though the aid of mathematics has furnished ample matter for its improvement.

The vertical wind-mill, which is the kind most common in use, consists of an axis or shaft A B (Fig. 1, Plate II. Wind-Mill) placed in the direction of the wind, and usually inclined a little upwards from the horizontal line. At one end of this, four long arms or yards, S, T, V, W, are fixed perpendicular to the axis, and crofs each other at right angles; into these arms small crofs-bars are morticed at right angles; and other long bars are joined to them, which are parallel to the length of the arms; so that the bars intersect each other in the manner of lattice-work, and form a surface, on which a cloth can be spread to receive the action of the wind. These are called the sails; they are in form of a trapezium, and are usually nine yards long and two wide.

The circular motion is produced by the obliquity of the planes of these surfaces, from the plane in which all the four arms are situated; by these means, when the wind blows in the direction of the axis, it does not impinge upon the sails at right angles to their surfaces, but strikes obliquely; hence the effect of the sail to recede from the wind, causeth it to turn round with the common axis, and the four sails are all made oblique in the same direction, so as to unite their efforts for the common object.

That the wind may act with the greatest efficiency upon the sails, the wind-shaft must have the same direction as the wind. But as this direction is perpetually changing, some apparatus is necessary for bringing the wind-shaft and sails into their proper position; this is done by turning the axis and sails round in an horizontal direction. There are two methods of effecting this. In the old mills, like Fig. 1, the whole of the mill or building on which the machinery is fastened upon a vertical post, firmly fixed as a stand or foot, upon which the whole machine can be turned by a lever, to prevent the sails to any quarter of the horizon from whence the wind blows; and hence these are called post wind-mills, and are necessarily made of wood. The other kind, Fig. 2, is called a smock-mill, in which only the dome-cap or head, which contains the axis of the sails, and covers the great cog-wheel, turns round horizontally; the other parts of the machinery being contained in a fixed building, which rises up in form of a conical tower of masonry, and is surmounted by this moveable cap or dome, which is supported on rollers, so as to turn round easily.

As both the common methods of adjusting the wind-shaft require human assistance, it would be very desirable that the same effect should be produced solely by the action of the wind. This may be done by fixing a large wooden vane or weathercock at the extremity of a long horizontal arm, which lies in the same vertical plane with the wind-shaft.

By these means, when the surface of the vane and its distance from the centre of motion are sufficiently great, a very gentle breeze will exert a sufficient force upon the vane to turn the machinery, and will always bring the sails and wind-shaft to their proper position. This weathercock, it is evident, may be applied either to machines which have a moveable roof, or to those which revolve upon a vertical axis. This method is practised in small machines; but a vane of sufficient power to turn a large mill about would be unwieldy. A much better method is therefore practised in the best mills, as we shall soon describe.

In a post-mill the building must necessarily be of small size, and it can only contain one pair of mill-joiners. For this purpose, a large cog-wheel is fixed upon the main-shaft or axis of the sails; the cogs are placed in the face or flat surface of the wheel, and act upon the teeth of a pinion, which is fixed upon the horizontal axis or spindle of the mill-joiners. The mill-house is of a rectangular figure, but narrow in the direction which is perpendicular to the wind; it is two stories high, the main-shaft and mill-joiners being in the upper chamber, whilst the lower is used to contain the sacks of flour, and also to receive the pole on which the mill turns round, horizontally to face the wind. This pole is a very strong tree, and is held perpendicularly by fixing it upon the middle of long timbers, which form a large cross on the ground, and are the baum of the whole mill.

The pole is fixed perpendicularly by means of several oblique braces, extending from the ground-cros to the middle part of the pole; but ten or twelve feet from the upper end of the pole, the brace must be round, and clear from the obstruction of the braces. This part of the pole rises up through the middle of the lower chamber, in the floor of which a circular collar is formed, to surround the lower part of the pole exactly. At the upper end of the pole is a pivot or gudgeon, which enters into a socket fixed in the middle of the upper floor, and to one of the strongest crossbeams, because this beam must sustain the whole weight of the mill. In this manner, the whole mill can turn about upon the vertical pole, but remains always in equilibrium. To make it firm, and prevent it from turning about at every moment, a strong framing is united by joints to the back part of the mill-house, and defends in a sloping direction till it touches the ground; it is furnished with leps, so that it serves as a broad ladder to ascend to the mill; but another use is to steady the mill, because the end of this frame, which is very heavy, rests on the ground, and the shorter poles are fixed in a circle round the mill at regular intervals, to which the end of the ladder is fastened with cords. In order to turn the mill about, a rope is fastened to the end of the sloping ladder, and is carried up to the top of the mill in an inclined direction. By means of a strong lever, or a tackle of pulleys, this rope can be shortened, so as to lift up the ladder clear of the ground; and then, by pulling it like a long lever, the whole mill is turned round. To obtain more force, a small capstan is often provided to draw a rope.
WIND-MILL.

A rope attached to the end of the ladder. This capstan is moveable, and is fastened at pleasure to any one of the poits which are fixed in the ground.

The internal mechanism of a poit wind-mill is exhibited in fig. 3. Plate II. Wind-Mil. A B O is the upper room; H O the lower room; A B the axis passing through the mill; S, T, V, W, the sail, covered with canvas, let obliquely to the wind, and turning round in the order of the letters in fig. 1; C the cog-wheel, having about forty-eight cogs, which carry round the lantern E, having eight or nine rounds, together with its spindle G N; K is the upper mill-stone, and L the lower room; Q is the bridge supporting the axis or spindle G N; this bridge is supported by the beams e and X Y, wedged up at e and Q; X Y is the lifting-tree, which stands up right; a b and c d are levers, whose centres of motion are a and a; f g h i is a cord, with a flone, j; it goes about the pin g and b, to wind it up and raise the flone at pleasure. The spindle t N is fixed to the upper mill-stone K, by a piece of iron called the yoke, and fixed in the lower side of the flone, which is the only one that turns about, and whose whole weight rests upon a flone fixed, in the bridge Q R at N. The trundle E, and axis G t, may be taken away; for it rests by its lower part at t by a square socket, and the top runs in the edge of the beam w. By bearing down the end f of the lever e, b is raised, which raises x y, and this raises X Y, which lifts up the bridge Q R, with the axis N G, and the upper mill-stone K; and thus the flones are set at any distance. The lower immovable flone is fixed upon strong beams, and is broader than the upper one: the flour is conveyed through the tunnel n o into a chest; P is the hopper, into which is put the corn, which runs along the fpout r into the hole s, and so falls between the flones, where it is ground. The axis G t is square, which shaking the fpout r, as it goes round, makes the corn run out; r s is a string going about the pin s, and serving to move the fpout nearer to or farther from the axis, so as to make the corn run faster or slower, according to the velocity and force of the wind. And when the wind is great, the falls S, T, V, W, are only in part or one side covered; or perhaps only one half of the two opposite falls. Toward the end B of the axis another cog-wheel may be fixed, with a trundle and mill-stones, like that already described; so that the same axis moves two flones at once; and when only one pair is to grind, the trundle E, and axis G t, are taken out from the other; s x y l is a girr or grisse of pliable wood, fixed at the end s; and the other end l is tied to the lever k m, moveable about k; and the end m being put down, draws the grisse s x y l close to the cog-wheel; and thus the motion of the mill is flapped at pleasure; p q is a ladder for ascending to the higher part of the mill; and the corn is drawn up by means of a rope, rolled about the axis A B, when the mill is at work.

The structure of the mill-stones, or grinding parts, is the same as the water-mills. See Mill.

It is plain that this construction confines all the machinery to the two chambers, or that part of the mill which is poited upon the vertical pole; hence this kind of windmill is unfit for any other purposes than that of grinding corn, and for expressing oil, because there is so little room for the machinery. The Dutch, who are famous for windmills, make them sometimes with a very large poit, which has a hole down through the centre of it, like a trunk, and through this, a perpendicular axis passes to convey the power of the mill down into a building below, and upon the top of which, as a roof, the foundation-beams of the poit are fixed. (See fig. 4.) In this way, the mill is applied to saw wood, or to make paper, or any other purpose; but the construction is complicated, and less effective than the other kind of mill, in which only the head or top turns round, as we shall now describe.

The Smock-Mill.—This is the best kind of mill, because the building which contains the machinery may be made of any required dimensions, the falls and turning cap being all at the top of the house. Fig. 3. in Plate I. Wind-Mill, is a vertical section of one of these mills. K K are the walls of the house, and O O strong timbers forming a roof to it; upon these eight principal timbers H are erected, to form an octagonal pyramid of carpentry, the sides of which are filled up by diagonal bracing, and small uprights to nail the boarding to.

The four falls are fixed on an iron axis B N, by screwing them to an iron cross formed at one end of it. Two of these falls are marked A A; but the other two are endways, and cannot be seen. Upon the axis within the mill the cog-wheel C is fixed; and this turns a trundle or lantern D, fixed on the upper end of a strong vertical shaft, E E, extending from the top to the bottom of the mill, to turn the machinery; on the lower end of it is a large wheel, f g, which are two pinions, g g, upon the spindles of the mill-stones b b. These are on the same conduction as those described in our article Mill, to which we refer. At l is a wheel upon the main axis, giving motion to a pinion on a horizontal shaft or roller, k, which has a rope wrapped upon it, to wind up the tacks of corn. The wheel k also turns a similar horizontal axis with several wheels, to receive endless ropes for turning the bolting and dressing machines.

We will now enter more fully into the mechanism of the upper part of the mill, which is called its head or cap, marked G, and contains the axis B N. This is supported upon bearings, one being near its falls, and the other at its extreme end, as is shown in fig. 5. Plate II. Wind-Mill, which is an horizontal fection of the head, shewing the circular kirb, or wooden ring, K, and the framing which is bolted upon it to support the axis.

The construction of the axis is shewn in fig. 6. of the same plate. It consists of an octagonal iron shaft with two cylindrical necks at e and d, where it rests upon its bearings. At the end it has a kind of box, which has two mortises, e and f, through it in perpendicular directions to receive the falls. At the back of one of these mortises, and the front of the other, a projecting arm is left in the cutting to receive screw-bolts, which hold the falls fast in the mortises. The cog-wheel is fixed on by bolting its arms against a flanch C, cast on the axis. The falls are braced by a rope-stray to each arm, proceeding from the end of a pole, which is fixed at the end of the cafl-iron axis. Each fall is formed of a fall-cloth, spread upon a kind of lattice-work or framing, composed of rails mortised into the arms of the falls. The plane of this frame is inclined to the plane of the falls' motion at such an angle, that the wind blowing in the direction of the axis acts upon the falls as inclined planes, and turns them about with a power proportionate to the size of the falls and force of the wind. It is necessary, as the wind changes its direction, to turn the falls about, that the axis may be always in the direction of the wind. (See fig. 3. Plate I.) This motion is effected by turning the head of the mill round upon the fixed part, on a circle or kirb at the top of the frame composing the house of the mill. At the bottom of the frame of the wood-cap is a circular or moveable kirb, between which and the fixed kirb a number of rollers are placed; and the moveable kirb of the cap lies upon these rollers, which are kept equidistant
equidistant from each other by their centre-pins being fitted into a circular hoop: by these means, though the head of the mill with the wheels and sails weighs several tons, they can be made to turn round to face the wind by a slight power.

The head is contrived to turn itself about whenever the wind changes in the following manner:—A small pair of fans, or fads, M, are fixed up in a frame L, projecting from the back of the head: it has a pinion of ten leaves upon its axis, engaging in a wheel of 62 teeth upon an inclined axis b; and this has a pinion of 172 teeth upon a vertical iron axis, at the lower end of which is a pinion of 11 teeth: this works in a circle of 120 cogs, fixed round on the outside of the fixed kibb. By these means, whenever the fan M is turned, it moves the head of the mill slowly round, and with proportionate power.

Now if ever the wind varies in the leaf from the direction of the main shaft of the sails, it acts obliquely upon the vane of the fan, and turns them round, at the same time setting the head right again, so that the axis points to the wind. But when the axis is in this situation, the wind blows in the planes of the vane of the fan, and has no effect upon them. The head of the mill is kept firmly in its place when it turns about by rollers; the axles of which are bolted to the inside of the framing of the head, and the rollers apply to the inside of the fixed kibb: there are four of these rollers. The pivot at the upper end of the vertical shaft is supported in a bearing bolted to a cross-beam in the framing of the head of the mill; and this is fixed precisely in the centre of the head, so that it may not vary in its situation as the head turns round. Many other things are so evident in the drawing as to need little farther explanation; such as the different floors of the building, and the circular gallery, I I, all round the mill, for the miller to go round to take the cloth off the sails in high winds, or when the mill is to stop. This is done by untying the cloth at the extremity of the sail, and twisting it up like a rope; then tying the end of it again to the lattice, in which state it presents no surface to the wind. At l is a roller turned round by a wheel I, fixed on the middle part of the vertical shaft: it is used to draw up the sacks of corn from the bottom of the mill into the upper part, which is used as a storehouse for the corn, being divided into as many compartments as the miller requires.

The mill-floines are made the same as those used in water-mills. A pair of regulating balls are attached to the upper part of the mill-floine spindle, to regulate the velocity of the mill. The manner of applying this regulator is explained in fig. 5.

Plate II. Wind-Mill. The lower end of the iron spindle F is fitted to a square, formed on the top of the mill-floine axis, and the pinion g g is fixed on the upper end, to give motion to the floines: immediately beneath the pinion two rods are jointed, hanging downwards, having a heavy iron ball, I, fixed fast on the lower end of each: two links are jointed to the arms at m, and suspend a collar, which is capable of sliding freely up and down upon the spindle F. It is evident that when the balls fly out from the spindle by their centrifugal force, that the collar will be elevated, and the contrary when the balls approach the spindle. The sliding collar is embraced by a fork formed at the end of a beelyard, lying horizontal, and suspended by the rod p as a fulcrum; an iron rod q descends from the extreme end of the beelyard, having its lower end jointed to a hook, by which it is connected with a lever, r, whose fulcrum is s; this, by an iron rod t, suspends one end of the beam called the bridge, on which the lower pivot of the mill-floine axis rests, the other end bearing on a fulcrum or centre. Now it follows from this arrangement of levers, that by elevating the forked end of the beelyard, or the sliding collar, that the spindle of the floines will be suffered to descend a very minute quantity. This regulates the velocity of the mill, because when the wind increaseth, and the motion of the mill is accelerated, the balls fly out by the centrifugal force; this lets the upper floine down nearer to the lower, thereby increasing the resistance to the mill, and counteracting the increased force of the wind. On the other hand, if the wind falls, and the mill moves more slowly in consequence, the balls fall together, and let down the sliding collar; this raises the floine up, and increases the distance between them, thereby diminishing the resistance; for this purpose, a weight o (fig. 5.) is hung upon the beelyard, sufficient to elevate the floine whenever the closing of the balls and consequent descent of the collar will permit it to do so. There are several notches made in the beelyard for different positions of the fulcrum p and rod q; by means of these the quantity of the regulation can be adjusted to the following rule. If when the wind blows stronger the mill goes slower, contrary to the effect expected, it shews that the regulation is too active; then increase the leverage of the balls by shortening the distance between the fulcrum p of the beelyard and the suspension of the rod q, by shifting either of them into different notches. On the contrary, if the mill goes much faster when the wind increases, it shews that the regulation does not act sufficiently; then increase the distance between the rod q and the fulcrum p. If the whole limits of the notches in the beelyard should not be sufficient to effect this, the adjusting length of the lever r s must be increased or diminished by removing its fulcrum s to a greater or lesser distance from the suspending-rod t; by means of this converse the miller is enabled, without much inconvenience, to regulate the velocity of the floines to that degree which is found best for reducing the greatest quantity of grain to flour, without damaging it by heating, as is the case when the floines move too quick.

Theory of the Motion of a Wind-Mill, with the Position of its Sails or Vanes.—The angle which the surfaces of the sails are to make with their common axis, that the wind may have the greatest effect, or the degree of weathering, as the millwrights call it, is a matter of nice inquiry, and has much employed the thoughts of the mathematicians.

To conceive why a wind-mill moves at all, the theory of compound motions must be supposed. A body moving perpendicularly against any surface, strikes it with all its force. If it move parallel to the surface, it does not strike it at all: and if it move obliquely, its motion, being compounded of the perpendicular and parallel motion, only acts on the surface, considered as it is perpendicular, and only drives it in the direction of the perpendicular. So that every oblique direction of a motion is the diagonal of a parallelogram, whose perpendicular and parallel directions are the two sides. Add, that if a surface, which, being struck obliquely, has only received the perpendicular direction, be fastened to some other body, so as that it cannot pursue its perpendicular direction, but must change it for some other; in that case, the perpendicular itself becomes the diagonal of a new parallelogram, one of whose sides is the direction which the surface may follow; and the other, that which it cannot.

Thus, a rudder fastened obliquely to the keel of a vessel, being struck by the current of water parallel to the keel, and, of consequence, obliquely with regard to itself; it will appear, by drawing the line of perpendicular impulse, that it tends to tear the rudder from the keel, and to carry it away: and that this direction, perpendicular to the rudder,
wind-mill.

The rudder, then, would be carried off in an oblique direction; but as, in reality, it is so secured, that it cannot be torn and carried off, we are only to consider, in this compound motion, that of the two directions wherewith it can move without being torn from the keel; and leave the other, which would tear it off, as useless.

Now, the direction in which it can move without parting from the keel, is that which carries it circularly about its extremity, as about a centre. So that the effect of the oblique impulse of the water on the rudder is reduced, first to a perpendicular impression, which is again reduced to the mere turning of the rudder round; or, if the rudder be immovable, to the turning of the vessel. Now, in an oblique and compound motion, where only one of the directions is of service; the greater ratio the other has to it, the less effect will the motion have, and vice versâ. In examining the compound motions of the rudder, we find, that the more obliquely it is to the keel, the ratio of the direction that serves to turn it to the other is the greater. But, on the other hand, the more obliquely it is to the keel, and, of consequence, to the course of the water which is suppos’d parallel to it, the more weakly it strikes. The obliquity of the rudder, therefore, lies, at the same time, both an advantage and a disadvantage; but as they are not equal, and as each of them is still varying with every different position of the rudder, they become complicated variously; so that sometimes one prevails, and sometimes the other.

It has been a point of inquiry to find the position of the rudder, in which the advantage should be the greatest. M. Renan, in his famous theory of the working of ships, as found, that the best situation of the rudder is, when it makes an angle of fifty-five degrees with the keel. Seeudder.

If, now, a wind-mill, exposed directly to the wind, should have its four fails perpendicular to the common axis in which they are fitted, they would receive the wind perpendicularly; and it is visible that impulse would only end to overturn them. There is a necessity, therefore, to have them oblique to the common axis, that they may receive the wind obliquely.

For the greater ease, let us only consider one vertical fall. The oblique impulse of the wind on this fall is reducible to a perpendicular impulse; and that direction, as the fail cannot absolutely keep to it, is compounded of two; one of which tends to make it turn on its axis, and the other to fall backwards. But it is only the first of these directions that can be obeyed. Of consequence, the whole impulse of the wind on the fall has no other effect but to make it turn from right to left, or from left to right, its acute angle turns this way or that. And the structure of the machine is so well contrived, that the three other fails are determined, from the same causes, to move the same way.

The obliquity of the fails, with regard to their axis, has precisely the same advantage and disadvantage with the obliquity of the rudder to the keel. And M. Parent, seeking, by the new analysis, the most advantageous situation of the fails on the axis, finds it precisely the same angle of fifty-five degrees.

For the farther illustration of this point, let A B (Plate II. Wind-Mill, fig. 7.) be the axis of the mill, C D a fail, and its angle of obliquity (viz. that which it makes with the axis) E C G; then if G C be the force of the wind in the direct position of the fail, G E (the force of the angle of incidence G C E) will be the force of the wind in its oblique situation; but the force of G E is resolvable into two others, E F and G F; of which the latter, being parallel to the axis, avails nothing in turning the fails about it; but the other, E F, being perpendicular to it, is wholly spent in compelling the fail to turn round. The force of the wind on the fail will be as the square of the force of incidence, or as G E^2; and if the area of the fail, and the velocity of the wind, be suppos’d constant, the force of the wind in the direct position will be to that in the oblique one, as G C to G E^1; but when G E is the whole force, that part which turns the fail is represented by E F; and G E : E F (: G C : C E) :: G E^2 : G C

= to the force which turns the fail, when the whole force is represented by G E^3. This expression begins from nothing, when the angle of incidence begins to be oblique, and increases with the obliquity of the said angle to a certain number of degrees; because that part of the force which is parallel to the axis, becomes less in proportion to that which is perpendicular to it; but after it has passed this limit, it again decreases, and becomes nothing, when the angle of incidence vanishes. There is, therefore, one certain position of the fail, in which the force of the wind upon it is a maximum. In order to find this, put radius G C = a, E C = x, and we have G E^3 = a x x, and consequently the force \[
\frac{C E \times G E^2}{G C} = \frac{a x x - x x x}{a},
\]
which must be a maximum: therefore its fluxion \(a x x - 3 x x x = 0\): whence \(a = 3 x, \) and so \(x = \sqrt{\frac{a a}{3}} = (\text{in logarithms}) 20.000000 - 0.477121 \cdot \frac{2}{\pi} = 9.761439,\) which is the logarithmic sine of the angle 35° 16' = C G E; and therefore the angle \(E C G = 54° 44',\) when the force of the wind is a maximum. Thus, also, if \(l m (\text{fig. 7.})\) parallel to the axis Q M, be equal to a, and represent the whole force of the wind on the fail; this force is reduced to \(l n,\) and this again to \(n o,\) which acts perpendicularly to the axis, and turns the fail. This force, putting \(m n = x,\)

is expressed by \(\frac{a x x - x}{a},\) and thus, as before, when it is a maximum, \(x = \sqrt{\frac{a a}{3}} = a \sqrt{\frac{1}{3}};\) and the angle \(l m n = 54° 44'.\) Martin’s Phil. Brit. vol. i. p. 220, vol. ii. p. 212.

This angle, however, is only that which gives the wind the greatest force to put the fall in motion, but not the angle which gives the force of the wind a maximum upon the fail when in motion; for when the fail has a certain degree of motion, it yields to the wind; and then that angle must be increased, to give the wind its full effect. Mr. Maclaurin, in his Fluxions, vol. ii. p. 734, has shown how to determine this angle.

It may be observed, that the increase of this angle should be different, according to the different velocities from the axis to the extremity of the vane or fail. At the axis it should be 54° 44', and hence continually increase, giving

3 R

the
the vane a twist, and so causing each rib of the vane to lie in a different plane.

It is observed, that the ribs of the vane or fail ought to decrease in length from the axis to the extremity, giving the vane a curvilinear form; so that no part of the force of any one rib be spent upon the rest, but all move on independent of each other. The twist above-mentioned, and the diminution of the ribs, are exemplified in the wings of birds. As the end of the fail nearest the axis cannot move with the same velocity which the tips or farthest ends have, although the wind acts equally strong upon them, Mr. Ferguson (lect. on mechanics, p. 52.) suggests, that perhaps a better position than that of stretching them along the arms directly from the centre of motion, might be to have them set perpendicularly across the farther ends of the arms, and there adjusted lengthwise to the proper angle. For, in that case, both ends of the fails would move with nearly the same velocity; and being farther from the centre of motion, they would have so much more power, and then there would be no occasion for having them so large as they are generally made; which would render them lighter, and, consequently, there would be so much less friction on the thick neck of the axle, when it turns in the wall.

M. Parent considered what figure the fails of a wind-mill should have, to receive the greatest impulse from the wind; and he determined it to be a sector of an ellipse, whose centre is at the axis, or arbor, of the mill; and the little semi-axis the height of thirty-two feet: as for the greater, it follows necessarily from the rule that directs the fail to be inclined to the axis, in an angle of 55 degrees.

On the foundation he assumes four such fails, each of which is one-fourth of an ellipse; which, he shews, will receive all the wind, and lose none, as the common ones do. These surfaces are multiplied by the lever with which the wind acts; one of them, expresses the whole power the wind has to move the machine, or the whole power the machine has when in motion.

The same manner of reasoning, applied to a common wind-mill, whose fails are rectangular, and their length about five times their breadth, shews, that the elliptic wind-mill has about seven times the power of the common one.

A wind-mill with four elliptic fails, he shews, would have more power than one with only four. It would only have the same surface with the four, since the four contain the whole space of the ellipse as well as the fix. But the force of the fix would be greater than that of the four, in the ratio of 245 to 231. If it were desired to have only two fails, each being a semi-ellipse, the surface would be something the same; but the power would be diminished by near one-third of that with fix fails, because the greatest of the sectors would much shorten the lever with which the wind acts.

**Bent Form and Proportion of rectangular Wind-Mills.**—As elliptical fails would be something so new, that there is little room to expect they will come into common use, the fame author has considered which form, among the rectangular ones, will be the most advantageous. And by the method de maximis et minimis, he finds it very different from the common ones.

The result of this inquiry is, that the length of the rectangular fail should be nearly double its length; whereas the length is usually made almost five times the width. Add, that as we call length the dimension which is taken from the centre of the axis, the greatest dimension of the new rectangular fail will be turned toward the axis, and the smallest from it; quite contrary to the position of the common fails.

The power of a wind-mill with four of these new rectangular fails, M. Parent shews, will be to the power of four elliptic fails, nearly as 13 to 23; which leaves a considerable advantage on the side of the elliptic ones; yet will the force of the new rectangular fails be considerably greater than that of the common ones.

M. Parent likewise considers what number of the new fails will be most advantageous; and finds, that the fewer the fails, the more surface there will be, but the less power. The ratio of the power of a wind-mill with six fails will be to another with four, nearly as 14 to 15. And the power of another with four will be to that with two, nearly as 13 to 9.

For a variety of curious experiments and observations concerning the construction and effects of wind-mill fails, by the ingenious Mr. Smeaton, see Phil. Trans. vol. ii. p. 138. &c.

Mr. Smeaton's experiments did not realize M. Parent's theory; for he found the fails fixed at the angle of 55 degrees with the axis, to be the least advantageous of any which he tried; but if the fails are included from 72 to 75 degrees from the axis, or 15 to 18 degrees to the place of their motion, the greatest effect will be produced that can be when the fails are plane surfaces.

He also found, that the elliptical fails, which intercept the whole cylinder of wind, do not produce the greatest effect, for want of proper interlaces for the wind to escape.

The following maxims, deduced by Mr. Smeaton from his experiments, contain the most accurate information upon the subject:

**Maxim 1.** —The velocity of wind-mill fails, whether unloaded or loaded, so as to produce a maximum effect, is nearly as the velocity of the wind, their shape and position being the same.

**Maxim 2.** —The load at the maximum is nearly, but somewhat less than, the square of the velocity of the wind, the shape and position of the fails being the same.

**Maxim 3.** —The effect of the same fails at a maximum are nearly, but somewhat less than, the cubes of the velocity of the wind.

**Maxim 4.** —The load of the same fails at a maximum is nearly as the squares, and their effects as the cubes of their number of turns in a given time.

**Maxim 5.** —When fails are loaded, so as to produce a maximum at a given velocity, and the velocity of the wind increases, the load continuing the same: 1st, The increase of effect, when the increase of the velocity of the wind is small, will be nearly as the squares of those velocities 2dly, When the velocity of the wind is double, the effects will be nearly as 10 to 27.5. But, 3dly, When the velocities compared are more than double of that where the given load produces a maximum, the effects increase nearly in the simple ratio of the velocity of the wind.

**Maxim 6.** —In fails where the figure and positions are similar, and the velocity of the wind the same, the number of turns in a given time will be reciprocally as the radius or length of the fail.

**Maxim 7.** —The load at a maximum that fails of a similar figure and position will overcome, at a given distance from the centre of motion, will be as the cube of the radius.

**Maxim 8.** —The effects of fails of similar figure and position are as the square of the radius.

**Maxim 9.** —The velocities of the extremities of the fails, in all their usual positions, when unloaded, or even loaded
led to a maximum, are considerably quicker than the velocity of the wind.

Rules for modelling the Sails of Wind-Mills.—Fig. 4.

Plate II. Wind-Mill, is a front view of one of the four sails of a wind-mill. The letters of reference will serve to explain the terms made use of in the following description.

1. The length of the arm or whip A A, reckoned from the centre of the great shaft B, to the outermost bar 19, governs all the rest.

2. The breadth of the face of the whip, A, next the centre, is one-thirtieth of the length of the whip; its thickness at the same end is three-fourths of the breadth; and the back-side is made parallel to the face for half the length of the whip, or to the tenth bar; the small end of the whip is square, and as its end is one-sixtieth of the length of the whip, or half the breadth at the great end.

3. From the centre of the shaft B, to the nearest bar of the lattice, is one-seventh of the whip; the remaining space of fix-sevenths of the whip is divided into nineteen spaces, so as to make nineteen bars; one-ninth of one of these spaces is equal to the mortise for the bars, the tenons of which are made square where they enter and go through the whip, and consequently the mortises must be square also.

4. To prepare the whip for mortising, strike a gage-score at about three-fourths of an inch from each end, and the gage-score, on the leading side 3, 5, will give the face of all the bars on that side; but on the other side the faces of all the bars will fall deeper than the gage-score, according to a certain rule. To find the space to be set off for this purpose for each bar, construct a scale in the following manner.

5. Extend the compasses to any distance at pleasure, so that the distance of the arms may be greater than the breadth of the whip at the seventh bar; let those fix spaces off upon a straight line for a base, at the end of which raise a perpendicular; let off three spaces upon the perpendicular, and divide the two spaces that are farthest from the base line into fix equal parts each; so that this quantity of two spaces may be equally divided into twelve spaces marked out by thirteen points; from each of these points draw a line to the opposite end of the base, as so many rays to a centre, and the scale is finished.

6. To apply this scale to any given cafe, set off the breadth of the whip at the last bar, (that is, the bar at the extremity of the sail,) from the centre of the scale along the base towards the perpendicular; and at this point raise a perpendicular to cut the ray nearest to the base; also set off the breadth of the whip at the seventh bar in the same manner, and at this point erect another perpendicular to cut the thirteenth radius. From the intersection of the perpendicular (drawn upon the breadth of the last bar) with the first of the thirteen radii, to the intersection of the other perpendicular with the thirteenth radius, draw an oblique line cutting all the rest, and the distances of each of these last-mentioned points of intersection from the base line is the space which the face of each bar is distant from the gage-line on the driving side.

7. These distances give a different set-off for each bar till the seventh, which fame must be set off for all the rest to the first.

8. The mortises must be square to the leading side of the whip.

9. When the mortises are cut, let the face of the whip be flopped off so as to agree with the face of the bars in every part.

10. Two-fifths of the whip are the length of the last or longest bar.

11. Five-eighths of the longest bar must be on the driving side of the whip, and three-eighths on the leading side, each being reckoned from the middle of the whip.

12. The proportion of the mortises already given determines the size of the bars at the mortises, but their thickness must be diminished each way, so as to be only one-half at the ends; but the face must be kept of equal breadth all the way.

13. The leading side goes no farther than the fourth bar, and there only projects one-third of the projection of the last bar.

14. All the bars on the driving side are made hollowing in the arch of a circle, which begins to spring one-third of the length of the bars on the driving side from the whip; and the sweep is such, that if a straight line is applied to the face of the bar from the whip to the end, the face of the bar should leave the straight line about the breadth of the bar.

15. There ought to be three uplongs, as 3, 2, 19, fig. 4, to the driving, and two to the leading side, as at 5, 4, to strengthen the lattice.

Self-regulating wind-mills are those which adapt themselves to the irregularities of the wind, by diminishing or increasing the surface on which the wind can act, to turn them round. If the wind increases in force, the surface exposed to its action is diminished; on the contrary, if it decreases in force, the surface will be increased in the same proportion, so as in some measure to render their motion uniform.

The following self-regulating wind-mill is stated as the invention of Mr. Andrew Mickle in 1772, the inventor of the threshing-machine. The length of the sail was divided into eleven compartments, by the bars forming a number of oblong openings, which were, each filled up by a square frame of wood covered with canvas, and mounted on pivots at their ends; one pivot turning in a hole in the whip, and the other in the bar which lies parallel to it, in the manner of a Venetian blind: the pivots were not placed in the middle of the breadth of the frames, but at one-third from that edge, towards the shaft or axis of the fails. On the end of each pivot which enters the whip a small roller is fixed, round which a chain passes, and its end is attached to a flax spring, placed at right angles to the whip, and in the direction of the length of the canvased frames. Now, if the wind blows too hard, it acts to turn the frames edgeway, in which case the flax passes through the fails, and exerts less force to turn them round; but as soon as the wind becomes moderate, the flax spring brings the frames into a plane, presenting their whole surface to its action. A rod of iron extends the whole length of the whip, and is connected with the several springs, to afford the means of strengthening or diminishing their action, according to the season of the year. This rod was formed into a screw at its outer extremity, and a nut put on to enable the miller to adjust the strength of the springs conveniently, from the circular gallery surrounding the outside of the mill.

Mr. William Cubitt of North Waltham, in the county of Norfolk, took out a patent, in 1807, for a method of equalizing the motion of wind-mill fails. It is similar to Mr. Mickle's, in the fails being made like a Venetian blind; but instead of the springs, he applied racks and pinions on the ends of the blind pivots, and a sliding rod, which passed in a small hole made through the length of the axis of the fails; the end of this rod within the mill was made...
made into a rack, working in a wheel upon which a weight was hung. By this means, when the wind blows too hard, the blinds turn upon their pivots, and by the racks draw out the rod which passes through the axis, and raise the weight; but as soon as the wind abates, the weight brings the blinds to their former position.

A patent was granted in 1804 to Mr. John Bywater of Nottingham, for a method of clothing and unclothing the fails of wind-mills while in motion. The invention consists in a manner of rolling or folding up, and unfolding again, the cloths of common wind-mill fails while in motion. It is effected by placing a long roller in the direction of the length of the whip round which the cloth is rolled; the inner end of the roller is furnished with a pinion, which engages in the teeth of a circular ring of cogs fixed to the shaft-head, close behind the back-rocks, with the liberty of turning round independent of the shaft. Another roller is placed at the back-side of the fail, round which several cords pass, and are conveyed over pulleys at the edge of the fail, and then made fast to the cloth at different distances along its length. The object of this second roller is to clothe the fail, in the same manner as the first-mentioned roller uncloathed it. The inner end of the back roller is furnished with a bevelled pinion, which acts in the teeth of a ring of cogs placed concentric with the one before described, which has also the liberty of turning round independent of the shaft. Suppose the fails to be completely clothed, and turning round by the wind, the two rings of cogs revolve with the axis, and therefore produce no effect on the pinions; but if the wind blows too violent, and it becomes necessary to partly unclothe the fails, the miller pulls a cord which is connected with a lever in the head of the mill. This lever comes in contact with a projection on the ring of cogs belonging to the rollers, upon which the cloth wounds. Now it is evident, that if the ring of cogs is held fast, and the fails continue to revolve, it will cause the pinions to turn round and roll up the cloth upon the rollers; on the contrary, if the wind falls, the fails will require to be more clothed, which is effected by the lever being moved farther, so as to quit the ring of cogs it held before, and hold the other fail, which will put the rollers at the back of the fails in motion, and by winding the cords upon them, draw the cloth off the tail-roller, which increases the surface for the wind to act upon. We have not entered into the minute details of this invention, as given in the patent, for it would have exceeded our limits, but only given a sufficient description to enable a person to understand the means of effecting the regulation.

**Horizontal Wind-Mills.**—These are of various kinds; but only one kind that we know of has been put to any valuable use.

Horizontal wind-mills were a favourite speculation a century ago; and the Theatrimum of the celebrated Leopold contain a great variety, but they are all upon one or other of two principles. In one of these, a very large wheel, like a water-wheel, is mounted with its axis in a perpendicular direction. It consists of several circular wheels fixed upon the axis; and it has large boards or vanea fixed parallel to its axis, and arranged at equal distances round the circular wheels. Upon these vanea the wind can act to blow the wheel round; but if the wind were to act upon the vanea at both sides of the wheel at once, it would have no tendency to turn the wheel round; hence one side of the wheel must be sheltered from the wind, whilst the other is submitted to its full action. For this purpose, the whole wheel is inclosed within a large cylindrical framing of wood, which is furnished with doors or shutters on all sides to open at pleasure, and admit the wind, or to shut and stop it. If all the shutters on one side be open, whilst all those on the opposite side are shut, the wind, acting with undiminished force on the vanea at one side, whilst the opposite vanea are under shelter, turns the mill round; but whenever the wind changes, the disposition of the open vanea must be altered, to admit the wind to strike upon the vanea of the wheel in the direction of a tangent to the circle in which the vanea move. A horizontal wind-mill is thus described in Leopold's Theatrimum Machinarum for grinding corn with one pair of fleses. A strong upright axis is fo poized on a pivot at the lower ends, and furnished in a collar or bearing, as to turn round. Into this several long arms are fixed, in the manner of radii, and at the extreme ends of each arm a vane is fixed, to receive the action of the wind. These vanea are made of two or more moveable leaves, which close up flat like a book, when they are at that side of the circle which moves in a direction to advance towards the wind; so that only the edges of the boards are opposed to the wind; but when these vanea arrive at the opposite side of the wheel, so that the wind blows upon them, the leaves fly open, and expose their full surfaces to the wind, and receive the impulse thereof.

A horizontal wind-mill is described by Dr. Hooke in the Philosophical Collections for 1681. It consisted of four vanea mounted upon vertical axes, and arranged round in a circle by the upper and lower pivots of the vanea being received into holes in the rims of two horizontal wheels fixed upon the same vertical shaft. The vanea were disposed in such a manner, that on one side of the wheel each vane presented its surface to the wind, whilst the one on the opposite side edgways, so as to move through the air without much resistance. This was effected by cog-wheels placed on the lower pivots of the vanea, and so arranged, that as one vane turned round upon its pivots, the whole number moved together, and the motion was given to them by a cog-wheel fixed fast to the framing over the wheel, but concentric with it. This wheel communicated, by means of an intermediate wheel, with the wheels on the axes of the vanea.

The action of this machine is as follows:—Suppose the wind blowing at the wheel; it acts against that vane which is at right angles to its motion, to turn the wheel round upon its axis. The opposite vane presenting its edge to the wind opposes very little resistance. The motion of the wheel upon its axis turns the vanea round upon their pivots, by means of the fixed cog-wheel before described; so that by the time that one has passed out of the direction of the wind, another arrives in the same perpendicular position; and when the wheel has made half a revolution, the vane which stood edgways will be perpendicular to the wind, and the one which before stood perpendicular will be edgways; thus a continued motion is produced without the wheel being caged up.

Horizontal wind-mills, which are inclosed in a house with blinds on all sides, are very fully described in Jacob Leopold's Theatrimum Machinarum, 1724; but we believe they were first practised in this country by captain Hooper, who erected one at Margate, and another at Battersea. The latter is upon a very large scale, and is used for grinding corn; but at present it does not work with much advantage, as the repairs are more considerable in proportion to the power it exerts, than in the mills with falls constructed in the common manner.

In Plate Wind-Mill. fig. 1, is an upright section, and fig. 2, a plan
WIN

This apparatus answers the purpose of the brake or grapple used in common wind-mills to stop their motion. By pulling the fall of the purchase $o$, it causes the iron strap to embrace the great wheel, and produce a resistance sufficient to stop the wheel. The mill can be regulated in its motion, or stop entirely, by opening or shutting the blinds $F$, which surround the fan-wheel. They are all moved at once by a circular ring of wood situated just beneath the lower ends of the blinds upon the floor $I$, being connected with each blind by a short iron link. The ring is moved round by a rack and spindle, which descend into the mill-room below, for the convenience of the miller.

A sort of wind-mill has been long much employed in Portugal, in which, from the difference in the construction of the fails, it is supposed by some, as Lord Somerville, who has inspected it when working, to possess a superiority in having the broad part of the fall at the end of the levers or booms; in consequence of which equal resistance is overcome with less length of branches; and that from this shortness a considerable saving is made in the timber of both the booms and spindles, as well as in the height, first coat of the mills, and their future repairs.

The advantages of making use of these sorts of wind-mills in preference to others are, that as there are four booms, as well as four masts for the falls, they are capable of being more easily braced out to the wind, and in case of a sudden gale or gulf of it, are more easily cast loose than in those of the common construction; and that as the fails in these mills are placed in the best possible direction by the booms, it is presumed that a wind-mill built on this plan and principle will do more work than any common wind-mill with an equal quantity of canvas.

These sorts of mills have also lately been very much improved by constructing and disposing those surface parts upon which the wind is intended to act, in such a particular manner, as that by alternately opposing a refilling and non-refilling surface, the whole force or impulse may operate in a direct manner upon the refilling side of the fall or vane, in proportion to its extent; and that when the non-refilling side is returning against these powers, the mill being so contrived that there is very little refilling, however large the surface. These improvements, when applied to horizontal wind-mills, the power of them, even with the same quantity of fall, or acting surface, may too be increased or diminished at pleasure, which is a circumstance of very great utility and convenience in many cases.

Wind-Pump, that sort of pump which is so contrived and formed as to be driven by the wind. These kinds of pumps are very useful for draining and lifting water in many cases, as where the depth of it is too great to admit of cutting drains, or the superficial too loose for forming them, and when the height to which the water is to be raised is great. See Surface-Draining.

Wind-Row, in Agriculture, a term signifying the green parts or borders of a field, dug up, in order to carry the earth on another land to mend it; so called because it is laid in rows, and exposed to the wind. It also signifies a row of peats set up to dry for fuel. Likewise a row of hay exposed to the wind and sun to get dry. And also of turfs or swart cut up in paring and burning.

The peats are set up in these rows in an open manner, to the height of two or three feet or more, that the wind may pass between and dry them. The rows of hay of this kind are either single or double, the former for that which is in the more gravelly soil, and the latter for that which has been more made; and the work is performed by different persons.
raking the spread hay in opposite directions towards themselves, and by such means forming a row between them of double the extent of that of the single wind-row. See Hay-Making.

The turf or sods for burning are set up in these rows, in leaning directions against each other, so as to let the wind readily pass among and dry them in a quick manner for burning.

Whins are sometimes, too, formed into wind-rows for being burnt for the ashes. See Whin-After.

WIND-Sail, or Ventilator, in a Ship, is made of canvas, and used for circulating fresh air between the decks, and is in the form of a cylinder, or an obtuse-ending cone, and is adapted to the size of the ship. Four breadth of canvas are sewed together, and the outer selvages are joined with an inch seam, leaving one cloth four feet short of the top. A three-inch tabling goes round the top and bottom. It is kept distended by circular hoops, made of ash, fowed to the inside, one at top, and one at every interval of fix feet. The upper part, or top, is covered with canvas, and a small rope fowed round the edge; into which are spliced, at the quarters, the ends of two pieces of rope, that are fowed up to the middle, and an eye formed by seizing the bights. The length of a wind-sail is taken nine feet above the deck, to three or four feet below the lower hatchway; the quantity of canvas is obtained by multiplying the number of cloths by the length.

These, of which there are generally three or four in our capital ships of war, have the advantage of taking little room, of requiring no labour in working, and of a simple contrivance, so that they can fail in no hands. But their powers are said to be small in comparison with those of Dr. Hales's ventilators: they cannot be put up in hard gales of wind, and are of no efficacy in dead calms, when a refresment of air is most wanted. See Ventilator.

WIND-Seed, in Botany. See Arctotis.

WIND-Stop, a name given by our farmers to a dillertemperature to which fruit-trees, and sometimes timber-trees, are subjected.

It is a sort of brulée and diver throughout the whole substance of the tree; but the bark being often not affected by it, it is not seen on the outside, while the inside is twilled round and greatly injured.

It is by some supposed to be occasioned by high winds; but others attribute it to lightning. Those trees are most usually affected by it, whose boughs grow more out on one side than on the other.

The best way of preventing this in valuable trees, is to take care in the plantation that they are sheltered well, and to cut them frequently in a regular manner while young.

The winds not only twit trees in this manner, but they often throw them wholly down; in this case, the common method is to cut up the tree for firing, or other uses; but if it be a tree that is worth preserving, and it be not broken but only torn up by the roots, it may be proper to raise it again by the following method:—Put a hole be dug deep enough to receive its roots, in the place where they were; let the fragglag roots be cut off, and some of the branches, and part of the head of the tree; then let it be raised, and when the turn-up roots are replaced in the earth in their natural situation, let them be well covered, and the hole filled up with rammed earth; the tree will, in this case, grow as well, and perhaps better, than before. If nature be left to herself, and the tree be not very large, the pulling off the roots will raise it. Mortimer's Husbandry, vol. ii. p. 79.

WIND-Tackle Blocks, in a Ship. See Winding-Tackle.

WIND-Taught, in Sea Language, denotes the name as fliff in the wind. Too much rigging, high masts, or any thing catching or holding wind aloft, is said to hold a ship wind-taught; by which they mean, that the floors too much in her failing in a stiff gale of wind.

Again, when a ship rides in a main fires of wind and weather, they strike down her top-masts, and bring her yards down, which else would hold too much wind, or be too much diffused and wind-taught.

WIND-Throw, in Ornithology, a name given by some to the red-wing, and supposed to be given from their generally first appearing with us in windy seasons; but it appears more probably to be derived from the German name wint-throffel, or vine-thrush, from its doing great mischief there in the vineyards, by eating and destroying the grapes. Ray. WIND-Tumours. See TUMOUR.

WIND-Word, in Sea Language, denotes any thing towards that point from whence the wind blows, in respect of a ship.

WIND-Word, Sailing to. See Sailing.

WIND-Word Tide denotes a tide which runs against the wind.

WIND, in Geography, a river of America, which runs into the Connecticut at Windfor.

WIND Gap, a pass in the Blue Mountains of Pennsylvania.

WINDAGE of a Gun, is the difference between the diameter of the bore and the diameter of the ball.

The windage is not the same in England as it is abroad. With us, if the diameter of the shot is divided into twenty equal parts, then the diameter of the bore is twenty-one of these parts. The French suppose the diameter of the shot divided into twenty-six parts, and the diameter of the bore to be twenty-seven. Mr. Müller observes, that the less windage there is, the truer the shot will go, and having less windage to bounce from one side to another, the gun will not be spoiled so soon. Accordingly, he divides the diameter of the shot into twenty-four equal parts, and makes the bore twenty-five, which is a medium between the English and French method. Artillery, p. 84.

Dr. Hutton observes, that if the windage be one-twentieth of the caliber, which is the usual fize, no lefs than one-third or one-fourth of the powder escapes, and is lost. As the balls are often smaller than the regulated size, it frequently happens, that half the powder is lost by unnecessary windage.

Dr. Hutton also recommends the diminishing of the windage. See Gunnery.

WINDALA, in Geography, a town of Sweden, in East Bothnia; 65 miles E. of Walf.

WINDALL, a town of the slate of Vermont; 22 miles S. S. W. of Windfor.

WINDASS, WANASS, or WAXASS, an ancient term in hunting. Thus, to drive the windas signifies the chasing of a deer to a stand, where one is ready with a bow, gun, or to shoot. This is one of the customary servives of hies.

"—Omnes illi qui nunnuntur in bondagii tenitura, solebant vocari custumarii: & quotque nunc dominus ad venandum venerit, illi custumarii solebant fugare windassum, ad flabulum, in venatione ferorum belliarum secundum quantitatem tenenra fumeu." MS. de Confluet. Manier de Sutton Colfield, an. 3 Ed. II.

WINDAU, in Geography, a sea-port town of the duchy of Courland, near the mouth of the Wera, on the Baltic. It was the capital of a palatinate, and has a castle, once the residence of the Livonian knights; the states of Courland likewise held their assemblies here, which made it populous; but it is now much decayed, and chiefly supported by ship-building, and exporting pitch, tar, wax, &c.; 8 miles N. N. E. of Piltyn. N. lat. 57° 10'. E. long. 21° 32'.
Windeau. See Weta.

Windauk, a town of France, in the department of the Scheldt; 9 miles S.S.E. of Ghent.—Also, a town of the duchy of Berg; 21 miles E. of Bonn.

Windeken, a town of Germany, in the county of Hanau Munzenburg; 4 miles N. of Hanau.

Windelsbach, a town of the margravate of Anspach; 22 miles N.W. of Anspach.

Winder, in Agriculture, a term used provincially to signify to clean corn with a fan-machine. See Fan-Machine.

Winder-Meb, in Ornithology, the name of a bird of the larus, or gull-kind, the larus cinereus of Linnæus, moderately large, and described by Aldrovandus under the name of larus major.

Its head is remarkably large and thick, and is of a mottled colour of white and grey; its breast and belly are also variegated with the same colours, but they are somewhat paler; its beak is thick and strong, of a yellow colour, and very sharp, and the opening of its mouth very wide; its wings are variegated with white, grey, and chestnut colour, and both the tail and the four tail in black in them; the feet are webbed and yellow, the claws are sharp, and the hinder toe longer than in most birds of this kind. Ray's Zoology, p. 267.

Winders of Wood. See Wood-Winders.

Windham, or Wymondham, in Geography, a town of England, in the county of Norfolk, with a weekly market on Friday. The chief trade of the place is making wooden ware. In 1549, William Ket, one of the Norfolk insurgents, was hanged on the steeple of the church; 9 miles W.S.W. of Norwich. N. lat. 51° 34'. E. long. 1° 7'.

Windham, a large post-township of Greene county, in New York, comprising all that part of the country on the S. and W. of the summit of the Catskills or Catskill mountains; bounded N. by Durham, Cairo and Catskill, E. by the northern angle of Ulster county, S. by Ulster and a part of Delaware counties, and W. by Delaware county. It has a post-office, and is about 24 miles in length, its median breadth being about 12 miles.

It is mountainous, with much good pasturage-lands that yield excellent dairy. It is watered by the Schoharie creek, which has several mill-feats and small branches. Along these streams are some alluvial lands, which are rich and fertile. The view from the Catskills, over which is a road, is very grand and interesting. The W. part of Windham is about 35 miles W. from Catskill, its principal market. The population consists of 3965 persons, and the senatorial electors are 267.

Windham, a town of the state of Connecticut, on the Thames. It is the chief town of a county, to which it gives name. The county contains 28,611 inhabitants, and the town 2,176; 63 miles S.W. of Boston. N. lat. 41° 38'. W. long. 72° 11'.—Also, a town of the state of Vermont, in the county of Windham, with 782 inhabitants; 20 miles E. of Bennington.—Also, a county in the S.E. part of the state of Vermont, bordering on the Massachusetts. It contains 26,760 inhabitants.—Also, a post-town of New Hampshire, in Rockingham county, with 743 inhabitants; 40 miles S.W. of Portmouth.

Winding, twirling from an even surface, or not a direct plane.

Winding a Call, in Sea Language, denotes the act of blowing or piping upon a boatman's whistle, so as to communicate the necessary orders of hoisting, heaving, belaying, slackening, &c. See Call.

Winding-Engine, in Mining, a machine employed to wind or draw up cores or barrels out of a deep pit or shaft. There are several different machines employed for this purpose, and each has a different name.

The most simple winding-machine is a roller placed horizontally over the pit, to wind up the rope, by which the bucket is suspended; the roller is turned round by a handle at each end. This simple machine, which is called a wind-lafs, wind-up, or roller, is commonly used for well-digging, and formerly was the common machine for mines; but for mining on the present system more powerful machinery is required. In Derbyshire it is called a bowie, and the construction is very minutely directed in the ancient mining-laws of the district, called 'The King's Field.' A small model or effigy of a bowie, constructed according to law, and fixed up "in fight of all men," is still the sign of legal possession of a lead-mines, and one of these must be constantly maintained at every thirty-nine yards in length of the vein of ore; by these laws no man may work more than thirty-nine yards, and it is supposed that each one of these is a separate working and drawing up of the ore from the mine.

With this simple machine a man can work continually to draw up a weight of 7750 pounds, at the rate of one foot per minute, or any smaller weight with a proportionably quicker motion. This is a fair average of the strength of man, which has been determined by a number of experiments, as shewn in our article Water. The radius of a winch or handle should not be above fourteen inches, which describes a circle of 75 feet circumference; a man can turn this round twenty times per minute with convenience, and the motion of his hands will therefore be 14 feet per minute, at which rate a man can exert a force of 25 pounds according to our standard. To apply a man's force to the greatest advantage, we must not depart much from these proportions; but the load which is drawn up at one time may be varied according to the diameter of the roller or barrel on which the rope winds: for instance, if this barrel is seven inches diameter, it will draw up the weight only one-fourth as fast as the man moves the handle; and in consequence the weight may be $4 \times 25\frac{1}{2} = 102$ pounds, and this he will be able to wind up at the rate of thirty-seven feet per minute. It is best to employ two men, and make the two handles at right angles to each other; the roller may then be 14 inches diameter, and they can draw up the 102 pounds at the rate of 74 feet per minute. The roller should have two ropes wrapped upon it in opposite directions, and a bucket being suspended from each, one bucket will be drawn up as the other is let down, and no time will be lost.

The next machine is the horse-gin: it has a large drum or barrel to wind up the rope; the barrel is mounted on a vertical axis, which is provided with one or more long levers, to the extreme ends of which a horse is harnessed, and by walking round in a circle, the barrel is turned round, and the rope which descends into the pit or shaft, is wound up by wrapping round the barrel. The gin is placed at a convenient distance from the mouth of the pit, and the rope is conducted over a pulley at the top of the pit, to change the direction from horizontal to vertical. The horse-gin usually has two ropes wrapping round the barrel in opposite directions, and one winds up as the other unwinds. The two buckets or cores which are suspended in the pit at the same time, go up and down alternately, one full and the other empty, and the weight of the empty core, which is depending, tends in some measure to balance that which is coming up full.

The barrel must be turned in a contrary direction every time a barrel is drawn up, and for this purpose the horse is turned
A perfect equal motion is not necessary for horse-work, and if it is not so much in extremes as to strain the horse in one part of his journey, whilst he has nothing to do in another, he will work very well. Gentle ascents and descents in a road are found as advantageous to the action of horses as a road upon a perfect flat. The following is the construction recommended by Mr. Smeaton for a two-horse gin for a lead-mine. — The horse-track 36 feet diameter, and two horses are employed at once; the diameter of the drum is 14 feet; the weight to be drawn at once 54 cwt. or 644 lbs. exclusive of the bucket, because there are two, and the one serves as a balance for the other; depth of the pit 45 fathoms, or 270 feet; the girt of the rope 6½ inches. The counterbalance for the unequal weight of the great rope is constructed as follows: — Above the drum or rope-wheel, a smaller one, or balance-drum of one-fourth the diameter of the great drum, or 3 feet 6 inches, must be firmly fixed to the upright axis; also a little shaft or pit-muff be funk at a convenient distance from the machine; if this is opposite the great pit, it will require less bracing to keep the fixed parts of the framing at their proper distances. A hole must be made in the circumference of the small wheel, or balance-drum, through which the end of a rope is passed, and secured by a knot. This rope, which is for the counter-weight, is to pass over a pulley of 3 feet or more diameter, such as is used to direct the great ropes down the main shaft; but it must be strongly and substantially fixed, because there will be a greater strain upon it. Over this pulley the balance-rope goes down into a little pit funk for the purpose, and a balance-weight is hung to it, which must be double the weight of 4½ fathoms of the main pit-rope, and it will act as a counter-weight to the great pit-rope. The counter-weight must not, however, go down so as to touch the bottom of the little pit; and it must be so regulated as to be at the lowest point when the two buckets are at their meetings, half way down the main pit. Hence, whichever way the main drum turns round, the counter-weight will be drawn up, and will arrive at the top when either of the buckets arrive there; by this means, whatever be the weight of the rope, though it exceeds the weight of matter in the bucket, yet the horse will always have something to draw; whereas in the old horse-gins made at Newcastle, they had no other method than turning the horses at the point of equilibrium; and after that letting them draw the backward way, which obliged them also to walk backwards, till the bucket arrived at the top.

As a 6½-inch rope is far more than equivalent to the weight required to be drawn, the fame fort of rope will do for the counter-weight also; but as there will be a great deal of chafing at the hole where it is fixed to the little drum-wheel, in consequence of its bending alternately one way and then the other, it will be proper to fortify it there with the white leather made of horses' skins, and the hole itself should be rounded off on each side, so as to make the rope bend easily.

In the sinking of the little shaft, if there is any particular advantage or obstacle, the depth may be greater or less than a quarter part of the main shaft; but then the size of the little drum and counter-weight must be proportioned accordingly. If practicable, the pit had better be deeper; and if it was half the depth, then the little drum might be half the diameter of the large one, and the counter-weight would be no more than the weight of the rope in the great pit. On account of the expense of the balance-pit, the double conical drum, which requires no counter-weight, is much preferable to any machine with a counter-weight.

In our article Water we have given the experiments on the strength of horses; from which it appears that a proper load...
load for 1 horse to work eight hours in a day is 22,000 lbs. avoirdupois, to be raised one foot in a minute, or any smaller weight to be drawn quicker in proportion; hence the weight of 644 lbs. may be drawn by two horses at the rate of 71 feet per minute, or the whole depth of 45 fathoms in 3½ minutes. The horses will then walk in their circle rather more than three miles per hour; but 2½ miles is the best pace. Horses are frequently loaded much more than this, and indeed one strong horse may work this machine; but as he could only work a short time each day, it is better to employ two.

When mines were sunk to very great depths, the drawing of the ore by horse-gins became too expensive, particularly for coal-mines, and more effective winding-machines were introduced. The water-gin was the first of these. The most simple of these is called a whimsey, and consists of a bucket, which is let down full of water, and by its descending force, draws up a loaded basket or corve from the bottom of the pit. (See WHIMSEY.) This machine requires a very considerable fall of water, and it can rarely be less than one-fourth or fifth of the whole depth from which the coal or ore is to be drawn.

In cafes where the fall is smaller, an over-shot water-wheel is employed; and in order to make the wheel turn at pleasure either way round, so as to wind up or let down, the wheel is made double; that is, with two rows of buckets, one row adapted to receive the water from a spout, which will cause it to turn round in one direction, and the other row of buckets is supplied with water from a different spout, and will turn the wheel in the opposite direction. Each spout is provided with valves to stop the stream at pleasure, and when one is open the other must be shut, and thus the wheel may be made to turn either way round. This is a very old invention, and is fully described by Agricola in his De Re Metalllica, 1551. It was at one time in very common use in the collieries, and they raised up the supply of water for it by a pump applied to the beam of the fixed steam-engine, or sometimes by an engine on purpose.

Mr. Smeaton made a machine, in 1774, for drawing coal at Griff, in Warwickshire, by a water-wheel, in which the motion of the wheel is always continued in the same direction; and by a change in the communication of the wheel-work, the barrel is made either to draw up or to let down. In 1777 Mr. Smeaton made a larger machine for Long Benton colliery, at Newcastle, which is worked by the water raised by a steam-engine on Newcomen’s principle.

The water-wheel and machinery are represented in Plate Winding-Engine, in several different elevations. X is the over-shot water-wheel, which is 30 feet in diameter; it is mounted on a cast-iron axis, which is clearly represented in the drawing. The water is delivered upon the wheel by a spout from a trough or chitter, which is supplied by the pump of the steam-engine. This trough is supported on tall piers of masonry, one of which is shown in the sketch. Upon the axis of the water-wheel are fixed two cog-wheels, U, V, of 88 cogs each, and the cogs are turned towards each other; W is a trundle, which is situated between the two wheels, and is turned round by either of them, according as it is placed; but it is smaller in diameter than the space between the two wheels, so that it cannot engage with both wheels at the same time. The trundle is fixed at the extremity of a long shaft, as shown in the plan, fig. 1; and the opposite end of this shaft is connected with the barrel on which the ropes are wound: this barrel is composed of two cones, joined together at their bases. The ropes from the barrel are conducted over pulleys at the top of the pit, as flown in the elevation, fig. 2, and descend into the same. The baskets, or corves, in which the coals are brought up, are hooked to the ends of the two ropes; so that by the motion of the water-wheel one basket is drawn up whilst another is let down.

To regulate the motion of the machine, two brakes or gripes are applied: one encompasses the great cog-wheel U, which is fixed on the axis of the water-wheel, in the same manner as the brake of a wind-mill; and in like manner, the fixed circle or brake is provided with a lever, as shown in fig. 4, by means of which the brake can be drawn tight round the wheel, and will then cause such a friction as to stop the water-wheel and all the machine.

The other brake-wheel DC (fig. 1) is fixed near the end of the long axis, and has clogs or pieces of wood applied at the top. This piece of wood is supported by a lever A B, as shown in fig. 2, A being the centre; and to the other end, B, a box E is suspended, and contains as much weight as will press the clog upon the wheel, with the force necessary to retain the corve from descending when it is full loaded. To enable the man at the mouth of the pit to lower down the corve, a cord is fastened to the lever A B, and is conducted over the pulleys, g k and k, to the mouth of the pit, where it hangs down in a knot, which the man can always reach, and by pulling it, he raises up the lever, and releases the wheel from the clog. To prevent accidents, if the clog and lever A should fail to stop the machine, another clog and lever F G are applied beneath the wheel; this lever is drawn upwards by a cord and a block of pulleys O, which are attached to the lower part of the weight for the upper lever. This cord is conducted to the pit’s mouth, and hangs down, so that the man can always reach it, and by pulling this, he compresses both the upper and lower clogs upon the wheel at the same time, which will be certain to stop it even if it be in a rapid motion; but he only refers to this lower clog on occasion, as the curb-rein is used for a horse; the weight of the upper lever, like a horse’s bridles, being a sufficient check for common use.

To make the machine wind either up or down, the trundle W must be changed from one of the wheels, U or V, to the opposite one, and this will cause the barrel to turn in an opposite direction. The pivot of the trundle W is supported by the long upright beam shown in fig. 3, which is moveable on a centre at the lower end, so that by inclining it to the right or left, the trundle may be engaged with either of the wheels U or V. The requisite motion is given to the upright beam by two tackles of pulleys applied to the upper end of the beam, as shown in fig. 3.

The ropes of both these tackles are fastened together, and hang down in a loop in reach of a boy, who can pull it either way, and make the trundle engage with either wheel, so as to wind up or let down the corves at pleasure. This boy is always stationed in a small room immediately over the wheels U V, so as to have the brake-lever, as well as the upright lever, always at his command; likewise the shuttle of the water-wheel, which is fixed, as is shown in fig. 3. A lever is made to communicate with it, and from the opposite end of the lever a rod descends into the room, so that the boy, by pulling it, can open or shut the shuttle at pleasure. This he must do whenever the corve comes up, or rather before; and notice of the proper time is given by a large knot in the main rope. The water being then shut off, the wheel will continue to turn by its momentum until the corve comes fully up, but by that time will have diminished its velocity, so that the application of the brake will stop it without any strain; the man at the mouth of the
the pit also applies the brake on the wheel CD. Immediately the motion ceases, the boy pulls the tackle, which disengages the trundle W from the wheel, but without engaging it with the opposite one, and in consequence the barrel is detached from the water-wheel. A man now feizes the corve with a long hook, like a shepherd's crook, and draws it aside; then another man releases the clog or brake on the wheel CD, and the wheel and the corve immediately descend upon the ground at the side of the pit. The pulley over the pit is raised up to a considerable height, because the machine cannot be stopped exactly at the precise spot; but if the corve should be drawn up a few feet higher than necessary, no harm can ensue as soon as the full corve is landed and exchanged for an empty one; and the same is done at the bottom of the pit. The boy throws the trundle in gear with the opposite wheel, then draws the shuttle to let the water flow upon the wheel, and the wheel refines its motion.

For the facility of stopping the machine at the proper moment, Mr. Smeaton applied a piece of machinery, which he called a count-wheel. This received its motion from a pinion of 15 teeth, fixed upon the extremity of the pivot of the lantern W; the pinion gave motion to a small cog-wheel of 60 teeth, situated between the two great cog-wheels UV, being fixed at one end of a horizontal spindle; and at the opposite end of it was a pinion of eight teeth, which gave motion to the count-wheel. This wheel had 80 teeth, and was fixed in a vertical position. It had affixed to its plane two projecting pieces of iron, which operated upon a lever that was connected with the lever which lets down or draws up the shuttle to regulate the flow of water upon the wheel. These projections were fixed to the wheel as to be capable of regulation in such manner, that when the machine had worked long enough to have brought up the corve to the top of the pit, the projection of the count-wheel would seize the lever, and let fall the shuttle so as to stop the water-wheel at the proper moment, without any attention on the part of the boy. This could be easily regulated by the position of the projection on the count-wheel, and when once adjusted always operated correctly; for as the count-wheel turned only once for forty turns of the barrel, the machine would therefore draw up a corve from the bottom of the pit before the count-wheel made a complete turn.

As the two corves in the pit ascended and descended mutually, they must pass each other at half the breadth of the pit; and it sometimes happens that they strike together, and overheat the coals. The best remedy for this is to divide the pit in two, or make two separate pits, and the barrel may be situated between the two. As it is frequently impracticable to do so, a smaller projection was applied in Mr. Smeaton's machine upon the count-wheel, which acted in the middle of the course upon the lever, and raised it up so as to diminish the opening of the water-shuttle, and make the machine move slowly at the moment when the corves met and paffed each other; this prevented accidents.

The principal dimensions of this machine were as follows:—The cylinder of the steam-engine 20 inches diameter, and 5 feet 8 inches the length of stroke. It made 14 strokes per minute. It was on the principle of Newcomen, i.e., atmospheric, with injection into the cylinder. The pump was 18 inches bore, and 5 feet 8 inches stroke; it raised the water 33 feet high. This water, being conveyed in a trough to the machine, was delivered upon the water-wheel, which was 30 feet diameter, with 72 buckets; its cast-iron axis was 7 inches diameter; the great cog-wheels 12 feet diameter, with 88 cogs; the trundle 20 cogs, so that the barrel turned 4½ times for once of the water-wheel. The barrel was 5 feet 3 inches diameter in the middle, and 2 feet 1½ inches diameter at the ends; the whole length being 10½ feet. Upon the circumference of the barrel a spiral line is traced, and a groove, which receives half of the rope, to prevent the rope from slipping on the barrel.

The depth of the pit was 165 yards; and it was found, on a long course of experiments, that the total consumption of coals was one corve of coals to draw up 8½ corves from that depth. The machine would draw 18 score of corves, each containing 20 pecks and weighing 5½ cwt., every 12 hours.

The more modern winding-engines by steam are upon a much more simple construction. The power of the steam-engine is applied at once to the barrel which wins up the rope, with only one pair of cog-wheels; viz., a large wheel fixed on the axis of the barrel, and a smaller one on the axis of the fly-wheel of the steam-engine. These engines are frequently made on Newcomen's principle, as the consumption of coals is a small object, but Mr. Watt's engines are more manageable. As the steam-engine with a crank will turn either way, according as it is set in motion, it is very well adapted for winding-machines; the boys who manage them are very dexterous in stopping and turning them the contrary way. See Steam-Engine.

There are many ingenious contrivances for facilitating the landing of the corves when they come up to the pit's mouth. The bed is a platform, which runs upon wheels, and can be pushed over the pit's mouth, when the corve is drawn up, by means of a light carriage with one horse, which is backed on the platform beneath the corve, and pushes the platform over the pit by the same motion. The corve is lowered down upon the carriage, and then the horse draws the corve away; the same motion withdraws the platform from the pit's mouth, ready to let down an empty corve and draw up another full one.

In many modern pits, conductors are fixed in the pit. These are perpendicular rods, and the baskets have projecting parts which embrace the conductors, and guide the corve regularly up or down the pit.

In many collieries flat ropes are used. These are composed of four small ropes placed flat, side by side, and fastened together by a packthread, which pieces all the four ropes. These flat ropes are used, a barrel or drum of small size is used, and the coils of the rope wind upon the other, so as to form a spiral, and increase the diameter of the effective barrel as the rope winds up, so as to balance the weight of the rope. This was invented by Mr. John Curr, of Sheffield, who has several patents for machinery for manufacturing such flat ropes, as they are extensively used in Yorkshire.

In others, iron chains are used instead of ropes, and are found to answer extremely well.

Winding of Cotton. See Cotton Manufacture.

Winding of Silk. See Manufacture of Silk.

Winding-Screw Chefs-Prefis, in Rural Economy, a contrivance of this sort, in which the weight is paid, in the Gloucestershire Report on Agriculture, to be capable of being gradually let down on the vats. It is thus described:—A strong platform, or sill, is raised on four legs, about a foot from the floor; near the edge is made a channel all round, to carry off the whey as it is expressed, by a lip, into the pan or receiver. Two strong side-poles are morticed into the sill, reaching about six feet high; across which, about four feet high, is firmly fastened a strong bar, with an aperture in the centre large enough to let in the screw with ease. This screw is fixed, at the lower part, into a heavy cubical stone
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of two feet dimensions, or nearly: the upper part of the sere, having passed the perforation in the cross-bar, enters a nut or female sere, large in the middle, but worked off at the two ends fine enough to be grasped by the hand: by turning this nut, the weight is raised or let down on the cheese-vats underneath.

Where stones of the required weight and dimensions are not to be had, a wooden frame of the same size is used, which is filled with sand, pebbles, or rubble-stones.

The screw part of the press has, in many dairies, been lately superceded by the adoption of an apparatus less simple in its construction, though more easily worked. In which, on the right side of the press, a third upright is raised from the floor, and connected by two cross-bars, about a foot long, with the upright post parallel with it. About four feet high, a cylinder of wood, from five to six inches diameter, is inserted, passing quite through the additional upright, but kept to its place by a shoulder. To the end are fixed four spokes, or levers, or an iron handle, to which manual power is applied. A strong rope is fastened to and cooled round the cylinder, which passing over a pulley let lengthways into the upper bar, proceeds horizontally to another pulley, fixed directly over the centre of the weight, and by an iron hook attached to it. Very moderate strength will raise the weight, which in this construction slides with grooves fitted to the side-posts. The mechanical powers are varied in some presses by the use of a wheel of a foot or eighteen inches diameter, instead of the pulley; but the effect is similar. In either way of working the weight, there is a superiority over the old press, and little difference in the expense.

WINDING STAIRS. See STAIR.

WINDING OF WOOL, in Rural Economy, the practice of putting it up into fleeceves. There is some nicety required in this operation; all the loose ragged parts are to be turned inwards, so as to form a neat fold of fleece, and all the dirty parts removed. The work is done on a large table or bench for the purpose. In some cafes of expert winders, four hundred fleeceves can be wound in the course of the day.

WINDISCH FEISTRITZ, in Geography, a town of the duchy of Stieria, on the river Ptucka; 40 miles S. of Graz. N. lat. 46° 30'. E. long. 15° 28'.

WINDISCH Gram, a town of the duchy of Stieria; 18 miles N.W. of Cilley. N. lat. 16° 35'. E. long. 14°.

WINDISCH Landberg, a town of the duchy of Stieria; 12 miles E. of Cilley.

WINDISCH Mark, a part of Carniola, bordering on Hungary and Croatia.

WINDISCH Mainz, a town of the archbishopric of Salzburg; 54 miles S.S.W. of Salzburg. N. lat. 46° 55'. E. long. 12° 36'.

WINDISH, a village of Switzerland, near Konigsfelden, at the confluence of the Aar and the Reuss, in the canton of Berne, in which are found the ruins of the ancient city of Vindonifia, a fortress mentioned by Tacitus, which the Romans made a place of arms to frop the irritation of the Germans, and is said to have been the site of a hilltop. It was destroyed in the 7th century; 3 miles W. of Baden.

WINDISHGARTEN, a town of Austria; 16 miles S.W. of Austrian Aichlawn.

WINDLASS, or WINDLACE, a machine used for raising heavy weights, as guns, lances, anchors, &c. It is very simple, confiting only of an axis, or roller, supported horizontally at the two ends by two pieces of wood and a pulley. The two pieces of wood meet at top; being placed diagonally, so as to prop each other. The axis, or roller, goes through the two pieces, and turns in them. The pulley is fastened at top, where the pieces join.

Lastly, there are two flaves, or handspikes, which go through the roller, by which it is turned; and the rope, which comes over the pulley, is wound off and on the same.

WINDLASS, an horizontal machine, composed of timber, &c. and most used in merchant-ships for heaving up their anchors in lieu of a capstan. The body of the windlafs is octagonal, and is tapered from the middle to the ends by given dimensions. It is fawn from oak-timber of the finest quality, and the length between the cheeks is in one piece. But when fitted with an iron axle or spindle in the middle, it must be in two pieces. The ends without the cheeks are fitted with iron spindles, and have a hoop driven over their ends. The spindles must be very accurately let into the ends and middle of the body, that the axis of each may exactly agree in a right line. A bolt is driven through the body of the windlafs and each end of the spindles. On each end of the body is let on and securely bolted an iron pulley, with teeth or notches at every two or three inches. The pull, which are iron, are fixed against the sides of the pulleys, and fall into the teeth or notches of the pull, fo as to prevent it turning backwards when charged by the effort of the cable, &c. Holes or mortises are cut through, along the middle of the windlafs on each square, to admit the handspikes, and each square of the body is covered with elm or fir facings between the cheeks, on the working side of the windlafs. It is suspended by its axles or spindles in brafs hodings, or gudgeons, which are let in and bolted into a frame of oak-timber called the cheeks, which are let down the deck and bolted and pulled to the pull.

There are other methods of fitting windlafs, but this is recommended as the best.

WINDLASS-CHEEKS, pieces of oak or elm fastened to the sides of small vessels, and by which the ends of their windlafs are suspended.

WINDLE, in Geography, a township of England, in Lancashire; 10 miles N.E. of Liverpool.

WINDLESTRAW, in Agriculture, a term applied to the naked stems of the crested dog's-tail, and other natural grasses.

It is observed in the third volume of the Transactions of the Highland Society of Scotland, that the common poa there sometimes goes by the name of windelstraw-grafs. See Grass, and POA.

WINDMANNIA, in Botany. See WEINMANNIA.

WINO, in Geography, a sea-port town of Sweden, in the province of Smaland; 85 miles N. of Calmar.

WINDORS, a town of the bishopric of Passau; 10 miles W. of Passau.

WINDOT CREEK, a river of America, which runs into the Ohio, N. lat. 37° 39'. W. long. 80° 48'.

WINDOW, q. d. WIND-DOOR, an aperture, or open place, in the side of a house, to let in the air and light.

Before glass windows came into use, (for the antiquity and first introduction of which, see GLASS,) the window caturements were commonly made of a transparent stone, called speckulis lapicis, and thence called speckula; and before the speckula, veils were the only defence they had against the weather. Pitic. Lex. Antiq. in voc. Specularia.

We have various kinds and forms of windows; as glass-windows, wire-windows, horn-windows, &c. Arched windows, circular windows, elliptical windows, square and flat windows, round windows, oval windows, Gothic windows, regular windows, sultic windows; to which add light.
The chief rules with regard to windows are.

1. That they be as few in number, and as moderate in dimensions, as may conduce to other respects; inasmuch as all openings are weakenings.

2. That they be placed at a convenient distance from the angles, or corners of the building; because the parts ought not to be opened and eaves, whose office is to support and strengthen all the rest of the building.

3. That care be taken the windows be all equal one with another, in their rank and order; so that those on the right-hand may answer to those on the left, and those above be right over those below; for this situation of windows will not only be handsome and uniform, but also, the void being upon the void, the full upon the full, it will be a strengthening to the whole fabric.

As to their dimensions, care is to be used to give them neither more nor less light than is needful; therefore regard is to be had to the bigness of the rooms which are to receive the light. It is evident, that a great room needs more light, and, consequently, a greater window, than a little room; and e contra.

The apertures of windows, in middle-sized houses, may be four and a half or five feet between the jams; and in the greater buildings, six and a half or seven feet; and their height may be double their length at the least. But in high rooms, or larger buildings, their height may be a third, a fourth, or half their breadth, more than double the length.

Such are the proportions for windows of the first story; and, according to these, must those in the upper story be for breadth; but, as to height, they must diminish; the second story may be one-third part lower than the first, and the third story, one-fourth part lower than the second.

Windows, Arched. See Architrave.
Windows, Dormer, or Letherns. See Letherns, &c.
Windows, Scenography of. See Scenography.
Windows, Transept. See Transept.

Window and House Tax, is one of the assessed taxes transferred to the commissioners for the affairs of taxes. The duties charged annually with respect to the windows or lights in every dwelling-houses, (for which, see Tax,) are subject to the following regulations.

All skylights, and all windows or lights, however constructed, in flairecas, garrets, cellars, offices, and all other parts of dwelling-houses, to what use or purpose soever applied, and whether such windows or lights shall be in the exterior or interior parts of such dwelling-houses, to be charged to the said duties.

Every window or light in any kitchen, cellar, cellaret, buttry, pantry, larder, wall-house, laundry, bakehouse, brewhouse, and lodging-room, belonging to or occupied with any dwelling-house, whether the same shall be within or contiguous to or disjoined from the body of such dwelling-house, shall be charged to the said duties.

The said duties to be charged yearly upon the occupier or occupiers of the houses, cottages, or tenements, in respect whereof the said duties shall be charged, and to be in force for one whole year, from the 5th day of April in the year in which the same shall be charged, to be levied on them, or on their respective executors or administrators, except as hereinafter provided.

Where any change in the occupation of any house, cottage, or tenement, shall take place after the affinment shall be made, then the said duties shall be levied upon and paid by the occupier, landlord, or owner, for the time being, or on both or all of them, according to their times or pollion thereof, without any new affinment, notwithstanding such change in the occupation for the year that such house shall have been affinmed; provided, that where a tenant shall quit the same, on the determination of the lease or demise after an affinment made, and shall have given notice thereof to the assessor, the duty shall be discharged by the commissioners for this act for the remainder of that year, in case it shall appear to them at the end of such year, that such house, &c. shall have continued wholly unoccupied during the remainder of such year.

Where any dwelling-house is or shall be let in different apartments, tenements, lodgings, or shop, and shall be inhabited by two or more persons or families, the same shall nevertheless be charged as if inhabited by one person or family only; and the landlord or owner shall be deemed and taken to be the occupier, and shall be charged with the said duties: provided, that where the landlord shall not reside within the limits of the occupier, or the said house remain unpaid by him for twenty days after the same is due, the duties so charged may be levied on the occupier or occupiers respectively, and such payment shall be deducted and allowed out of the next payment on account of rent.

Every house, of which the keeping is left to the charge of any person or servant, shall be subject to the like duties as if it were inhabited by the owner or by a tenant; and, if such person or servant shall not pay rates to the church and poor, the said duties shall be paid by the respective owners or tenants of the said house.

Every distinct chamber or apartment in any of the inns of court, or of chancery, or in any college or hall in either of the universities of Oxford or Cambridge, or any public hospital, being severally occupied, shall be subject to the same duties as if an entire house, which shall be paid by the respective occupiers; provided, that every such chamber or apartment, which shall not contain more than seven windows or lights, shall be charged at the rate of 3d. for every such window or light.

All dwelling-rooms in any hall or office whatsoever, belonging to any person, or to any body politic or corporate, or to any company, lawfully charged with the payment of any other taxes or parish-rates, shall be subject to those hereby payable, and be respectively charged as dwelling-houses; and the tenant, &c. to whom the same shall belong shall be charged as the occupier or occupiers thereof.

When a partition or division between two or more windows or lights, fixed in one frame, is of the breadth of space of twelve inches, the window or light on each side of such partition or division shall be charged as a distinct window or light.

Every window extending so far as to give light into more rooms, landings, or stories than one, shall be reckoned and charged as so many separate windows as there are rooms, landings, or stories enlightened thereby.

Every window or light, including the frame, partitions, and divisions thereof, which by due admeasurement of the whole, or the window, or light, shall exceed in height twelve feet, or in breadth fourteen feet nine inches, except being less than three feet six inches in height, shall be reckoned and charged as two windows or lights, except such windows or lights as shall have been made of greater dimensions at any time prior to April 5, 1785; except also the windows or lights in such parts of dwelling-houses as are used for shops, workshops, and warehouses, and except the windows or lights in the public room of any house licenced to sell wine, or other liquors by retail, shall be used for the entertainment of guests; and the windows or lights in farm-houses especially exempted from the duties.
duties in the schedule marked (B.), or in any dwelling-house not chargeable to the duties mentioned in the said schedule.

Where any dwelling-house shall be divided into different tenements, being distinct properties, every such tenement shall be subject to the same duties as if the same were an entire house, which duties shall be paid by the respective occupiers; provided, that every such tenement, which shall not contain more than seven windows or lights, shall be charged at the rate of 3s. 6d. for every such window or light; and every such tenement in Scotland, which shall not contain more than seven windows or lights, shall be charged at the rate of 3s. for every such window or light.

The cafes in which windows are exempted are the following.

1. Any house belonging to his majesty, or any of the royal family, and every public office, for which the duties heretofore payable have been paid by his majesty or out of the public revenue.

2. Any hospital, charity-school, or house provided for the reception and relief of poor persons, except such apartments therein as are or may be occupied by the officers or servants thereof, which shall severally be assessed, and be subject to the said duties as entire dwelling-houses.

3. The windows in any room of a dwelling-house, licensed according to law as a chapel for the purposes of divine worship, and used for no other purpose whatsoever.

Provided that every such hospital, charity-school, house for the reception and relief of poor persons, or room licensed as a chapel aforesaid, shall be brought into charge by the aforesaid or aforesaid, or in their default, by the surveyor or inspector, and shall be rated on the certificate of assessment as such; and on due proof of the facts before the commissioners by the aforesaid, it shall be lawful for the commissioners for executing the said act to discharge such hospital, &c. from the said duties, or such part thereof as is hereby intended to be exempted, in like manner as they are authorized to discharge the assessment on poor persons by this act, but not otherwise.

4. The windows or lights, in any dairy or cheese-room, belonging to and occupied with any dwelling-house, chargeable with the said duties, although the same shall be part thereof, which shall be used by the occupiers for the purpose of keeping butter or cheese, being their own produce, for sale or private use; provided, that the windows or lights in such dairies or cheese-rooms shall be made with tiles or wooden laths, or iron bars, or wires, and wholly without glass, and that the occupiers of the dwelling-houses to which such dairies and cheese-rooms belong shall cause to be painted on the outer door thereof, or on the outside of the windows, or one of them, in large Roman letters, the words, "dairy, or cheese-room," as the case may require, and shall keep such words so painted distinctly legible, during all such time as such exemption shall be claimed; and provided, that such dairies or cheese-rooms shall not be ever used to dwell or to sleep in by any person, but shall be wholly kept for the several purposes hereinbefore mentioned; and provided also, that an assessment of all such windows or lights shall be duly made, and the fact be truly returned in the manner directed by this act, in other cases of exemption from the said duties, so that the number of windows so to be exempted may be ascertained, and the exemption be allowed by the commissioners for executing this act.

The provisions that respect the exemptions of windows from assessment by 43 Geo. III. c. 161 are as follow.

Windows are to be stopped up with stones or brick, or the same kind of materials as the outside of the house; allowing being made for those in the roof made of the same materials with the outside of the roof, or stopped up before the commencement of this act; or windows are not to be made, restored, or stopped up without six days' previous notice given to the surveyors, under a penalty of 10l. ; and surveyors are to charge windows newly made or restored, and omitted in the assessment; and the penalty on stopping up windows to elude payment is a charge on the occupier of the tenement, at the rate of double the sum by which the assessment shall be augmented, by reason of such certificate, subject to appeal, provided it is proved to the satisfaction of the commissioners for executing this act, that the same windows or lights were respectively stopped up according to the directions of this act, previous to the commencement of the year on which the said assessment shall or ought to have been made.

The duty on dwelling-houses (for which, see Tax) comprehends every coach-house, stable, brewhouse, washhouse, laundry, woodhouse, bakehouse, dairy, and all other offices, and all yards, courts, and curtilages, and gardens, and pleasure-grounds, belonging to and occupied with any dwelling-house, within the limits of one acre.

All shops and warehouses which are attached to the dwelling-house, or have any communication therewith, shall, in charging the said duties, be valued together with the dwelling-house and the household and other offices aforesaid thereunto belonging, (except such warehouses and buildings upon or near adjoining to wharfs which are occupied by persons who carry on the business of wharfers, and who have dwelling-houses upon the said wharfs for the residence of themselves or servants employed upon the said wharfs.)

And also except such warehouses as are distinct and separate buildings, and not parts or parcels of such dwelling-houses, or the shops attached thereto, but employed solely for the purpose of lodging goods, wares, and merchandise, or for carrying on some manufacture (notwithstanding the same may adjoin to or have communication with the dwelling-house or shop.)

Every chamber or apartment in any of the inns of court, or of chancery, or in any college or hall in any of the universities of Great Britain, being severally occupied, shall be charged thereto as an entire house, and on the respective occupiers thereof.

Every hall or office whatever belonging to any person or to any body politic or corporate, or to any company lawfully charged with the payment of any other taxes or parishes, shall be subject to the duties as inhabited houses; and the person, &c. to whom the same shall belong shall be charged as occupier.

Where any house shall be let in different stories, tenements, lodgings, or landings, and shall be inhabited by two or more persons or families, the same shall nevertheless be charged to the said duties as if inhabited by one person or family only, and the landlord or owner shall be deemed the occupier, and shall be charged to the said duties; provided, that where the landlord shall not reside within the limits of the collector, or the same shall remain unpaid by such landlord for the space of twenty days after the same is due, the duties so charged may be levied on the occupier or occupiers respectively; and such payment shall be deducted and allowed out of the next payment on account of rent.

No dwelling-house, or other such premises as aforesaid, shall be estimated or rated at any less annual value than the rent or value at which the same premises stand charged in the last rate made on or before the time of making the
affeſſment for the relief of the poor in the same parifh or place, under certain specified restrictions with regard to the poor rate.

Where any dwelling-house shall be divided into different tenements being diſtinct properties, every such tenement shall be subject to the fame duties as an entire house, which duty shall be paid by the occupiers respectively.

The cafes of exemption are the following.

1. Any house belonging to his majesty, or any of the royal family, and every public office for which the duties heretofore payable have been paid by his majesty, or out of the public revenue.

2. Every dwelling-house, being a farm-house occupied by a tenant, and bona fide used for the purposes of husbandry only.

3. Every dwelling-house, being a farm-house occupied by the owner thereof, and bona fide used for the purposes of husbandry only, which, together with the household and other offices aforesaid, shall be valued under this act at 10l. per annum, or any lefs sum.

4. Any hospital, charity-school, or house provided for the reception or relief of poor persons.

5. Every house whereof the keeping is committed to the care of any perfon or ſervant, who doth not pay rates to the church and poor, and who refers therein for the purpose only of taking care thereof: provided, that an affeſſment shall be duly made in every ſuch cafe, and the fact be truly returned in the manner directed by this act in other cafes of exemption from the ſaid duties, and the exemption be allowed by the commissioners for executing this act.

Any perfon inhabiting a dwelling-house, containing not more than fix windows in the whole, ſhall be exempted from the duties in schedule (A.), in ſaid ſuch perfon ſhall be upon the books of ſuch parifh or place as receiving parochial relief; and ſhall not be affeſſed, or liable to be affeſſed to any of the duties contained in schedules (B.), (C.), (D.), or (E.); which several exemptions ſhall be proved or claimed in the manner hereinafter mentioned.

And, in order to relieve ſuch perſons who may be charged to the several duties ſet forth in the schedules (A.) and (B.), or either of them, it is enacted, that where any ſuch house, cottage, or tenement, as is deſcribed in the preceding clause, ſhall be brought into charge, and the occupier thereof ſhall be entitled to the ſaid exemption by reaſon of poverty, in every ſuch cafe, the affeſſors ſhall, on the certificate of affeſſment, fet oppoſite the ſum charged on the occupier thereof, the fact of his or her being poor, and ſhall return the ſame, together with the affeſſment and a certificate, as hereinafter mentioned, to the commissioners for executing this act in the diſtrict where ſuch affeſſment ſhall be made; who, before allowing any ſuch affeſſment, or making any order thereupon, ſhall examine the affeſſors, who ſhall reſpectively attend them for that purpoſe, at ſuch time as they ſhall appoint, touching the return so made; and if the ſaid commissioners ſhall, from ſuch examination, and from the certificate hereinafter mentioned, be ſatisfied that ſuch occupier is entitled to ſuch exemption, they may, after ſuch proof, strike out the charge, leaving his name, and the number of windows and rent of ſuch house in the affeſſment, and ſuch occupier ſhall be exempted accordingly; which exemption ſhall, in the like cafes, extend to, and ſhall be allowed on all affeſſments on ſuch poor perſons, of the duties payable at the time of paſsing this act, ſuch ſhall have been, or ſhall be made, at any time after the commencement of the preſent year.

But before any ſuch exemption or abatement ſhall be allowed, the affeſſors ſhall produce to the commissioners a certificate under the hands of five or more ſubſtantial householders of ſuch parifh or place, in ūſtrry ſealed, of whom the ſaid minister ſhall be one; but in cafe there ſhall be no ſuch minister ſaid therein, then at leaſt two or more churchwardens and overeers of the poor of ſuch parifh or place ſhall concur with ſuch ſeholders in ſuch certificate, ſertifying thereby, that they have carefully examined the affeſſment of theſe duties, and the allegations therein made by the affeſſors, touching ſuch perſons who ſhall be therein ſlated to be poor, and that in their judgment and belief the perſons therein ſertified to be poor are entitled to be exempted by reaſon of their poverty, and are wholly unable to pay the duties affeſſed upon them; provided, that if in any parifh or place there ſhall not be five ſubſtantial householders, then ſuch certificate may be made by the ſubſtantial householders thereof reſiding; or if there ſhall be no churchwardens or overeers, then the fame may be granted by the ſaid minister, or by any two churchwardens or overeers of any adjoining parifh or place, who can certify the truth of ſuch allegations, concurring therein with the ſubſtantial householders ſeiding in the parifh or place where ſuch affeſſment ſhall be made.

And where the occupier of any ſuch, cottage, or tenement, containing more than the number of windows or lights before ſpecified, ſhall be brought into charge, and the occupier thereof ſhall, at the commencement of the year for which ſuch affeſſment is made, be poor and indigent, or ſhall become so during that year, in every ſuch cafe, ſuch occupier may give notice thereof in writing, rating the caufes to the affeſſor, or to the ſurveyor of the diſtrict in which ſuch house is ſituate, annexing thereto a certificate, under the hands of ſuch perſons as aforesaid, ſertifying that, in their judgment and belief, ſuch perſon is juſtly entitled to relief on account of poverty for the caufes mentioned in ſuch notice; and every affeſſor ſhall deliver the notices by him received to ſuch ſurveyor: and if ſuch ſurveyor ſhall be ſatisfied of the truth thereof, after due examination of the caufes and circumstances, and that ſuch perſon is unable to pay the duties charged on him or her, and has no probable means of bettering his or her condition within that year, he is hereby required to certify the fame to the commissioners; and if ſuch ſurveyor ſhall not be ſatisfied, then, on notice thereof to ſuch occupier, he may appeal from ſuch charge to the commissioners, giving ten days' previous notice thereof to the ſaid ſurveyor.

And in every cafe where the ſurveyor ſhall certify to the ſaid commissioners that he is ſatisfied of the truth of the claim made by any ſuch occupier, and that he is, and will be unable to pay the duties charged on him or her within that year; or if, upon appeal, it ſhall appear to the ſatisfaction of the major part of the ſaid commissioners, preſent, on the oath of ſuch appellant, or by other lawful evidence on oath produced by ſuch appellant, that he or she is entitled to maintain ſuch appeal, and wholly unable to pay the duties charged on him or her, the ſaid commissioners may give ſuch relief, either by striking off the whole of the duty so charged, or diminishing the same, as to them shall seem meet and neceſsary; and which appeals, for the caufes in this clause mentioned, may be heard and determined, either on the days mentioned in this act for hearing appeals in other cafes, or at the end of the year, or any days to be appointed by the respective commissioners for executing this act; which exemption ſhall, in the like cafes, extend to, and ſhall be allowed on all affeſſments on ſuch poor perſons of the duties payable at the time of paſsing this act, which ſhall have been or ſhall be made at any time after the commencement of the preſent year.
Unoccupied houses are to be inlurled in the affection, and the affellors, or the surveyors and inspectors, are to certii when they become occupied, and the person occupying shall give notice to the affeiler, surveyor, or inspector, within twenty days after occupation, under a penalty of 5/-, and be liable to be charged for the rent of the preceding quarter; and houses becoming unoccupied after affection are to be charged for the whole year, unless notice is given. Notices are also to be given by occupiers of houses or managers of hospitals, charity-schools, poor-houses, or licensed chapels, entitled to exemptions; and the exemptions are to be allowed by the commissioners after examination. Burn’s Justiciary, vol. v. See Tax and Communication.

WIND, in Anatomy, &c. See Fenestra.

WINDRUSH, in Geography, a river of England, in the county of Oxford, which runs into the Thames, 5 miles S.S.W. of Witney.

WINDSCHACH, a town and citadel of Germany, in the principality of Ansbach; 10 miles S.E. of Ansbach. N. lat. 47° 15’. E. long. 10° 46’.

WINDSHEIM, a town of Bavaria. The inhabitants are chiefly Lutherans. This town was imperial till 1602, when it was given to the Elector of Bavaria; 28 miles S.W. of Wurzburg. N. lat. 49° 34’. E. long. 10° 26’.

WINDSOR, commonly called New Windsor, to distinguish it from a parish called Old Windsor, a market and borough town of Berkshire, England, is eminent in the historic annals of the kingdom, on account of containing one of the palaces of the sovereigns, and from the many distinguished events which are identified with the place. Some of our most eminent military and chivalrous sovereigns have made the castle, or palace of Windsor, their chief residence, and consequently the scene of various celebrated festivities, tournaments, and national assemblies. In the annals of the castle, this is fully verified. When the Domeday-book was compiled, the castle, which had been then lately built by William the Conqueror, was within the manor, and it is probable within the parish of Clewer, of which Windsor was formerly a chapelry; it afterwards became the seat of an extensive honor.

We are told by the Saxon Chronicle, that William the Conqueror kept his Whithuntide at Windsor in 1071; and that a synod was held there in 1072, wherein the province of York was made subject to Canterbury. It is probable, that William Rufus kept his Whithuntide at Windsor in 1095, his Christmas in 1096, and his Easter in 1097: but in all probability all these festivals were held at the palace at Old Windsor. Windsor-castle seems to have been intended by William the Conqueror more for a military poll, for which by its situation it was well adapted, than for the residence of himself and his successors.

Several monarchs kept their Christmas and other festivals at Windsor; on some of which occasions there were tournaments and other chivalrous fetes performed. After the contenstions between Stephen and Maud, Windsor-castle, as the second fortres of the kingdom, was committed to the custody of Richard de Lacy.

It appears that a new barbican, or out-work, was built to the castle by king Henry III. In 1265, during the wars between that monarch and his barons, prince Edward Garrisoned Windsor-castle with foreigners, who nearly destroyed the town, and did much injury to the surrounding country. The same year it was given up to the barons, and the king made an order that Eleanor, wife of prince Edward, with her daughter, and all her household, should, without delay, retire from the castle.

A great tournament was held in Windsor-park on the 9th of July, in the fifth of king Edward I. That monarch and his successor, king Edward II., resided frequently at Windsor, where several of their children were born.

John, king of France, and his son Philip, were prisoners in Windsor-castle. David, king of Scotland, is also said to have been prisoner there at the same time.

All historians agree, that Windsor-castle owes its magnificent fabric to the affection which king Edward III. bore to the place of his nativity. Wallingham relates, that in 1334, he built a chamber, which he called the round table, 200 feet in diameter: this, by other accounts, appears to have been only a temporary furniture. Holinshad says, that in 1359, the king set workmen in hand, to take down much old buildings belonging to the castle of Windsor, and caused divers other fair and sumptuous works to be set up in and about the same castle, so that almost all the masons and carpenters, that were of any account within the land, were sent for, and employed on the same works.” But it appears that various commissions for appointing surveyors and impriying workmen had been issued some years before; and that in 1356, William of Wykeham, then one of the king’s chaplains, was made clerk of the works with ample powers, and a fee of one shilling a day whilst at Windsor, and two shillings when he went elsewhere upon business: his clerk had a salary of three shillings a week. In 1359, the architect’s powers were further enlarged, and he was appointed keeper of the monars of Old and New Windsor. The next year 360 workmen were impriying to be employed on the buildings at the king’s wages, some of whom having clandestinely left Windsor, and engaged in other employments for greater wages, were ill-used to prevent persons employing them, on pain of forfeiting all their goods and chattels, and to commit such of the workmen as should be apprehended to Newgate. The plague having carried off a great number of the king’s workmen in 1352, new writs were issued to the sheriffs of several counties to imprison 302 masons and diggers of stone to be employed in the king’s works. The counties of York, Salop, and Devon, were to furnish sixty men each. Glaziers were imprisoned in the year 1363; very few commissions were issued after the year 1369, and none after 1373, so that it may be presumed that this noble work was then completed; compiling the king’s palace, the great hall of St. George, the lodgings on the east and south sides of the upper ward, the round tower, the chapel of St. George, the canon’s houses in the lower ward, and the whole circumference of the walls, with the towers and gates.

The appeal of high treason, brought by the duke of Lancaster against Thomas Mowbray, duke of Norfolk, in 1508, was heard by king Richard II., on a scaffold erected within the castle at Windsor, when, it being found impossible to reconcile the opponents, a day of combat was appointed to take place at Coventry. The castle continued to be the occasional residence of our monarchs, who from time to time made various alterations in the buildings, particularly king Henry VII. Windsor-castle was garrisoned by the parliament, soon after the breaking out of the civil war between Charles and his subjects; and colonel Venne, who was afterwards one of the king’s judges, was appointed the governor. Prince Rupert made an unsuccessful attack upon it in the autumn of 1642. The castle continued under the jurisdiction of parliament during the war, and in the year 1648 became the prison of its unfortunate monarch. Judge Jenkyns was also a prisoner here for several years; whence he was removed to Wallingford, in 1656.

Upon the Restoration, king Charles II. finding the buildings
ings of the castle much dilapidated by plunder and neglect, caused it to be thoroughly repaired and richly furnished. During the greater part of his reign, he made Windsor his summer residence. King James II. in 1687 received the pope's nuncio at Windsor-castle. Queen Anne, when princes of Denmark, lived in a small house adjoining the little park, and was very partial to Windsor.

During the reign of his present majesty, Windsor-castle has undergone considerable improvements, under the direction of the late James Wyatt, esq. surveyor-general of his majesty's works.

The castle consists of two courts, between which is the keep, or round tower. The upper court contains on the north side the state apartments, chapel, and the hall of St. George. The east and south sides have been lately fitted up for the residence of their majesties and the royal family. Our limits will not allow us to enter into a detail of the magnificent rooms which constitute the state apartments, or of dwelling on the valuable collection of pictures therein contained.

St. George's hall, on the north side of the upper ward, was built by King Edward III., as a refectory for the knights companions of the garter: it is a noble room 108 feet in length. The ceiling and walls are painted by Verrio; the subjects are the triumphs of the warlike founder, and his brave son, Edward the Black Prince.

In the area of the upper court is a bronze statue of King Charles II. on horseback, executed by Stada at the expense of the munificent Tobias Rustat.

On the north side of the castle is the terrace made by Queen Elizabeth, which was extended by King Charles II. along the east and south sides: its whole length is 1350 feet, and it may be regarded as the noblest walk of the kind in Europe, as well as the most interesting in situation.

The chapel of St. George is situated on the north side of the lower court of the castle. King Henry I. built a chapel at Windsor, dedicated to St. Edward the Confessor, and placed in it eighty canons, who were maintained out of the king's exchequer. This chapel appears to have been rebuilt, or considerably enlarged and decorated, by King Henry III.: that monarch, in the year 1243, intrusted a commission to Walter de Gray, archbishop of York, to expedite the works at the king's chapel at Windsor, directing that the workmen should proceed as well in winter as in summer, till the whole was completed; that a lofty wooden roof, like the roof of the new work at Lichfield, should be made to appear like flute-work, with good ceiling and painting: that the chapel should be covered with lead, and four gilded images be put up in it, where the king had before directed images of the same kind to be placed; and that a fluted turret should be made in front of the chapel of sufficient size to hold three or four bells. Some remains of Henry III.'s buildings, as may be presumed by the style of the arches and architectural decorations, may be seen on the south side of the dean's cloisters, and at the east end of the chapel behind the altar.

King Edward III., who had been baptized at Windsor, rebuilt St. Edward's chapel there, and dedicated the new structure to the Virgin Mary and St. George. In the year 1349, he augmented the number of canons to twenty-three, besides a warden; and appointed 24 poor knights, for all of whom he built habitations, and granted land for their support. In 1351, the bishop of Winchester made considerable alterations in the college; and Henry IV. changed the title of warden to that of dean.

The present splendid and truly interesting chapel of St. George may be regarded as the most perfect and most beautiful pile of ecclesiastical architecture in the kingdom. It was commenced by King Edward IV. and committed to the superintendence of Richard Beauchamp, bishop of Salisbury. The work was not completed till the reign of King Henry VIII.: the beautiful roof of the choir was put up in the year 1508. Sir Reginald Bray, prime minister to King Henry VII., and one of the knights companions of the order of the garter, who died in 1502, succeeded Bishop Beauchamp in the superintendence of this great work, and was a liberal contributor to the building of the choir and other parts of the fabric: his cognizance is frequently repeated on the roof of the choir, as are the royal arms and those of several noble families with the order of the garter. The roof roof and lantern were erected in 1516; the present organ-gallery and screen at the end of the choir are of Coade's artificial stone. The halls of the knights companions, which are very richly carved in wood, exhibit the names and arms of the several illustrious and noble persons by whom they have been respectively filled. The altar-piece, which represents the Last Supper, is by Mr. Wett, from whom designs the east window, representing the Resurrection of our Saviour, was executed in painted glass by Jarvis and Foreit, and put up in 1788: the expense of the latter was about 4000I. Another window by the same artists display the angels appearing to our Saviour. Many of these improvements, as well as several others in the chapel and castle, have been executed under the patronage, and partly at the expense, of his present majesty. Beneath the choir repose the remains of Henry VIII., his queen, lady Seymour, and king Charles I. Henry VI. was also interred in this chapel; also his rival and successor, Edward VI.

At the east end of the south aisle is the Lincoln chapel, which contains the monument of Edward, earl of Lincoln, lord high admiral of England for thirty years, who died in 1584. Sir Henry Clinton, bart., a descendant of the earl of Lincoln, was buried in this chapel in 1705. In the same aisle is an elegant chantry chapel, built by John Oxenbridge, canon of Windsor. Further west is a chapel built by Dr. Oliver King, bishop of Bath and Wells, who died in 1492.

In the middle of the south aisle is a spacious chapel, founded by Sir Reginald Bray, who died in 1502, and is here interred: his arms and crest appear in several parts of the chapel, particularly in the beautiful screen which separates it from the aisle.

At the west end of the south aisle is the Beaumont chapel, in which is an altar-tomb with the effigies of the founder, Charles Someret, earl of Worcester, who died in 1536, and his lady; and a splendid monument, supported by Corinthian pillars, to the memory of Henry, the first duke of Beaumont, who died in 1699.

Near the south door of the choir is interred Charles, duke of Suffolk, a favourite minster and brother-in-law of King Henry VIII., who died in 1543.

On the west side of the choir-door in the north aisle is a chapel built by Elizabeth, wife of William, lord Hatfield, who is buried here.

At the east end of the chapel is a distinct though attached building, called the tomb-house, which was commenced by Henry VII. and intended for his burial place. It was granted by Henry VIII. to cardinal Wolsey, who began a magnificent monument for himself within its walls. This was destroyed in the civil wars. James II. fitted up the building as a Roman Catholic chapel; and publicly attended the celebration of masses. After that monarch's decease the chapel was deserted; but in 1800 his present majesty gave orders
orders for it to be repaired, beautified, and appropriated for the interment of his family. The princes Mary and the princes Charlotte of Wales have been committed to its vault. On the north and east sides of the chapel are houses and lodgings for the dean and canons. The south and west sides of the lower ward are occupied by houses appropriated to the poor knights.

Between the two wards or courts of the castle is the keep, or round tower, for the residence of the governor of the castle. It consists of a lofty, artificial, conical mount, surrounded by a moat, and surmounted by a strong fortified tower, which is approached by a flight of 100 steps. The circumference of the whole castle is 4180 feet; its length from east to west 1480 feet; and the area, exclusive of terrace walks, is about twelve acres.

On the south side of the castle is a modern mansion, called the Queen's-lodge, where the royal family resided for several years; but it is now unoccupied. About half a mile S.E. of the castle is Froome, a modern fest built to the queen. It is principally noted for its beautiful garden.

To the south and west of the town is Windsor Forest, which formerly was computed to measure 120 miles in circuit. At present it is about 56 miles. A part of this, called the great park, consists of 3800 acres. The little park, on the north and east sides of the castle, contains about 500 acres.

Windsor is a large irregular town, disposed on the sides of a hill, and at its base, on the southern banks of the Thames. In 1276 it was declared a free borough by King Edward I., who granted to the burgesses a mercantorial guild, and various privileges and exemptions. He constituted it the county-town. King Edward IV. incorporated the burgesses by the name of mayor, bailiffs, and burgesses. By the later charter of King Charles II., the corporate body is made to consist of twenty-eight or thirty members. A weekly market is held by royal grant, as well as three annual fairs. Near the centre of the town is a guildhall or town-house, which was built in 1666.

This borough sent two members to parliament in the reign of Edward I.; but omitted making any return from 1340 to 1446. The right of election has frequently been contested, but was finally settled to be vested in all the inhabitant householders not receiving alms. Windsor has continued to increase in population for the last 300 years. In 1553, there appears to have been 1000 persons; in 1801, they amounted to 3461; and in 1811 to 6155, who occupied 1051 houses. The parochial church is a spacious building, and part of it ancient, though it was formerly only a chapel subordinate to the church of Clewer. In it are several old monuments. On the west side of the town are extensive barracks, and an hospital for sick soldiers.

Windsor, old, a village about two miles S.E. of New Windsor, was a place of some consequence at the time of the Domesday-survey, as by that record it is stated to contain 95 houses, which paid half a tax to the crown. Some of the Saxons kings had a palace here, and Edward the Conqueror sometimes kept his court at this place. After William the Conqueror had erected a castle at New Windsor, the old palace and the surrounding houses were gradually deserted. A great part of Windsor-park is within the parish of Old Windsor, and includes three lodges: 1. The great lodge built in the reign of Charles I. and occupied by the illustrious William, duke of Cumberland; 2. The little lodge or dairy, occupied by the deputy ranger; and 3. The minor lodge near Virginia water. Beaumont lodge, the seat of lord viscount Asbrooke, was originally built by Lord Weymouth, who died in 1705. There are other fa-

mily mansions and villas in this parish; one of which was lately fitted up and occasionally occupied by the princes of the house of Hanover.


The History of the Royal Residences, 4to. 1817, by J. Pyne, a very handsome and interesting work, contains several views of the state apartments in Windsor-castle. The Architectural Antiquities of Great Britain, 4 vols. 4to. by J. Britton, contains several views, and a full history and description of St. George's chapel.

Windsor, a large township in the south-east corner of Broome county, New York, erected in 1807 from the east part of Chenango, situated 15 miles E. of Chenango; bounded north by Chenango county, east by Delaware county, south by the state of Pennsylvania, and west by Chenango. Its extent is nearly 15 miles square, and it has two post-offices. It is traversed by the Susquehanna river. In 1810 it had eleven saw-mills, seven grain-mills, a fulling-mill, and carding-machine, eight school-houses, one house of worship, a population of 1960 souls, 138 electors, and nearly 300 families.

Windsor, a town of Nova Scotia; 25 miles N.W. of Halifax.—Alfo, a town of the state of Vermont, capital of a county of the same name, which contains 34,977 inhabitants; the town contains 2757 inhabitants; 92 miles N.W. of Boston. N. lat. 43° 33' W. long. 72° 22'.—Alfo, a town of the state of Connecticut, on the west side of the Connecticutt river, in the county of Hartford, with 2856 inhabitants; 3 miles N. of Hartford.—Alfo, a town of Massachusetts, in the county of Berkshire, with 1108 inhabitants; 156 W. of Boston.—Alfo, a township of Pennsylvania, in Berks county, with 1353 inhabitants; 70 miles W. of Philadelphia.—Alfo, a township of Pennsylvania, in York county, with 1739 inhabitants.—Alfo, a town of New Hampshire, in the county of Hillsborough, with 238 inhabitants.—Alfo, a town of North Carolina; 23 miles S.W. of Edenton.—Alfo, a township of Lower Canada, on the St. Francis.

Windsor, East, a town of New Jersey, in Middlesex county, with 1747 inhabitants.—Alfo, a town of the United States of America, in Connecticut, on the east side of the Connecticutt, opposite Windsor, with 3081 inhabitants.

Windsor, West, a town of New Jersey, in Middlesex county, with 1714 inhabitants.

Windsor, New, a poll-township of Orange county, New York, on the west bank of the Hudson; 100 miles S. of Albany; bounded north by Montgomery and Newburgh, east by the Hudson, south by Cornwall and Blooming-grove, west by Montgomery and Wallkill. Its medial ex-

tent east and west is eight miles, and north near four, giving an area of about 30 square miles. Its population in 1810 was 2331 persons, and its senatorial electors were 147. It has two post-offices, viz. the village of New Windsor, pleasantly situated on the west bank of the Hudson, and having considerable trade; and Little Britain, said to be discontinued in 1813. This township has several mill-reams, and the land is occupied chiefly by farmers, who enjoy much of the independence resulting from prosperous industry. The whole is well watered by springs and brooks.

Windsor Forest. See Windsor.

Windsor River, a river of the state of Connecticut, which runs into the Connecticut, 4 miles N. of Hartford.
WIN

WINDSOR Bean, in Agriculture and Gardening. See Bean, and Vicia.

WINDBERG, in Geography, a town of the duchy of Holstein; 4 miles S.S.E. of Meldorp.

WINDTHAAG, or WIndthag, a town of Austria; 3 miles E. of Bavarian Waldhoven.

WINDWARD PASSAGE, a name given to a course from the south-east angle of the island of Jamaica, in the West Indies, and extending from 160 leagues to the north side of Crooked island, in the Bahamas. Ships have often failed through this channel, from the north part of it to the island of Cuba, or the gulf of Mexico, notwithstanding the common opinion, on account of the current which is against it, that they keep the Bahama shore on board, and that they meet with the wind in summer for the most part of the channel easterly, which, with a counter current on shore, pushes them easily through it.

WINDWARD ISLANDS, in opposition to Leeward. These islands in the West Indies extend from Martinico to Tobago. See West Indies.

WINDWARD Point, a cape on the north-east coast of the island of St. Christopher. N. lat. 17° 23'. W. long. 62° 22'.

WINDY TUMOURS. See Tumour.

WINE, the fermented juice of the grape. The name is also applied to the fermented juice of other fubacid fruits.

It is impossible to fix the era when mankind first discovered fermented liquors. Some historians have ascribed the discovery to Noah, others to Saturn, others to Bacchus, &c. In short, almost every country in which the vine is indigenous has boasted of some individual or native deity, to whom the honour has been attributed; and if we reflect upon the simplicity of the process by essentially necessary to be had recourse to in making wine, it will appear exceedingly probable that the discovery was not made by one person or country exclusively, but by different individuals and nations at very different periods. A poet has elegantly represented wine as a recompence given by the deity for the miseries brought upon mankind by the general deluge:

"—— Deus nobis felicita vini
Dona dedit, trites hominum quo munere fovit,
Reliquias; mundi folatus vite ruimam."

Pradium Rufiticum.

Different kinds of wine were known at a very early period; and as civilization and luxury advanced, the number was greatly extended. Hence the cultivation of the vine became an object of importance, and many new varieties were produced, which, favoured by soil and situation, rendered particular places more famous than others. Thus the ancient Romans not only possessed a great variety of native wines, but, in the days of their greatest splendour, those also of distant and still more favoured climes, as the Vinum Chionum, Lejthinum, Leucadium, Rhodium, &c. &c. See Pliny, xiv. 6.

Little is known respecting the modes of manufacturing some of the most celebrated of the ancient wines. The general processes, however, did not perhaps differ much from those at present in use. The fruit was collected, bruised by the feet, and subjected to pressure, as now practiced. The juice that first flowed spontaneously was called χιττικα διχωμα by the Greeks, and by the Romans vinum primarium; such as was obtained by pressure was denominated διος, or vinum secundarium, and considered as inferior.

Both Greeks and Romans appear to have frequently concentrated their wines, either by spontaneous evaporation, or by boiling. For the former purpose, the wine was sometimes introduced into bladders or large jars, and exposed in the chimney to the heat of the fire, or in the upper parts of the house to the heat of the sun. Sometimes the fruit was converted into raisins by drying, and the wine prepared from such fruit was denominated παστεμ. At other times the must was reduced by boiling to one-half. This formed the vinum defrutum: occasionally even to one-third, when it was termed Sapa. (See Pliny, xiv. 9.) By one or perhaps more of these methods, the wines were reduced to the state of syrup, or in some instances even to dryness, and were capable of being preserved for a very long time. Thus Aristotle states, that the Arcadian wines required to be diluted with water before they were drank, as indeed was the case with most of the ancient wines; and Pliny speaks of wines as thick as honey, which it was necessary to dissolve in warm water, and filter through linen, before they were used. This was the case with the wine of Cacuba, according to Martial:

"Turbida folicito tranfmittere Cacuba facco."

Pliny mentions Staphylus as the first who mixed wine with water; but Athenaeus gives the credit of it to Amphitryon, king of Athens. On this occasion a fable was invented, that Bacchus, having been struck by a thunder-bolt, and being all inflamed, was presently cast into the nymphs' bath, to be extinguished.

These remarks, however, are applied by the authors chiefly to very old wines. Thus the wine compared by Pliny to honey had been made two hundred years before, in the time of conful Oppius: indeed wines of a hundred years old, and upwards, seem not to have been uncommon among the luxurious citizens of ancient Rome. (See Hor. od. iii. 14. 18. Juvenal, v. 34.) And similar allusions will be found in various other authors. Seven years was the shortest period, according to Ariosto and Galen, for keeping a wine before it was fit for drinking.

Among the Romans, the age of wines was, as it were, the criterion of their goodness. Horace, in his odes, which one may call Bacchic songs, boasts of his drinking Falernian wine, born, as it were, with him, or which reckoned its age from the fame consul.

The age of wine has been reckoned by leaves; thus they say, wine of two, four, or six leaves, to signify a wine that was two, four, or six years old; taking each new leaf put forth by the vine, since the wine was made, for a year. The moderns keep no wine to such an age as that mentioned by Pliny. Where they are kept the longest, as in Italy and Germany, there are scarce any to be found of above fifteen leaves. In France, the wines that keep best, as those of Dijon, Nantz, and Orleans, are reckoned superannuated at five or six years old.

Wine kept in a cool vault, and well secured from the external air, will preserve its texture entire in all the constituent parts, and sufficiently strong for many years, as appears not only from old wines, but other foreign fermented liquors, particularly those of China, prepared from a decoction of rice, which being well cloathed down in the vessel, and buried deep under ground, will continue, for a long series of years, rich, generous, and good, as the histories of that country universally agree in affirming us.

Sir Edward Barry, in his Observations, historical, critical, and medical, on the Wines of the Ancients, suggests, that our best modern wines, especially those of a delicate texture and flavour, may be more effectually preserved in earthen vessels of a larger size than our bottles, well glazed externally and internally: that dry sand is preferable for covering the bottles in the bins to sawdust; and that a
WINE.

small anti-cellar, built before all large cellars, would be a
considerable defence and improvement.

The ancients were fond of giving their wines an artificial
flavour, and for this purpose they introduced pitch, turpen-
tine, and different herbs into the at; a practice still fol-
lowed by the modern Greeks. Plin. ubi figura.

Such are the principal facts known respecting the cele-
brated ancient wines, which, as Chaptal judiciously remarks,
appear in general to have rather deferred the name of extraits
or syrups than wines. They must have been sweet and little
fermented, and consequently have contained a very small
proportion of alcohol. Indeed it is difficult to suppose how
they could contain any spirit whatever, or possess in con-
fsequence any intoxicating properties.

The above remarks, however, can be only applicable to
those wines which the refinements of luxury or caprice had
rendered valuable, from their uncommon occurrence, or the
difficulty with which they were procured. It is certain that
the ancients were well acquainted with the fermentative
processes, and ordinarily took advantage of it in the formation
of their wines; hence it is extremely probable that the wines
used in the primitive states of society, and perhaps at all
times by the common people, confined simply of the fer-
mented juice of the grape, and therefore differed in no
respects whatever from the wines in common use at the pre-
fent time.

General Principles of Wine-making.—We shall consider this
interesting subject under two principal points of view:
1. The manufacture of wine from grapes; and 2d. From
other fruits.

1. The manufacturing of wine from grapes is liable to be
influenced by a great variety of circumstances, such as cli-
nate, soil, aspect, season, &c.; some of the most important
of which we shall take a cursory view.

The vine is a native of the middle regions of the temperate
zone, that is to say, between the latitudes of 25° and 50°,
and here only does it flourish and mature its fruit in absolute
perfection. Indeed a belt comprised between the latitudes of
40° and 50°, may be said to include all the most cele-
bated vineyards of the northern hemisphere; from, namely,
of Spain, Portugal, France, Italy, Austria, Styria, Carinthia,
Hungary, Transylvania, and part of Greece. The
vine grows beyond the latitude of 50°, but its juices are
auflere, and without the requisite degree of succulence
matter to form good wine. The fine aromatic odour and
flavour of its fruit also are not developed much beyond this
latitude. In the southern hemisphere, which is colder than
the northern, the vine flourishes somewhat nearer the
equator.

The vine grows in every foil, but that which is light and
gravelly is best adapted for its cultivation. It flourishes ex-
tremely well also in volcanic countries. Thus some of the
belt wines in Italy are made in the neighbourhood of Feru-
vius. The famous Tokay wine is also made in a volcanic
district, as are several of the belt French wines; many parts
of the south of France bearing evident marks of extinct
volcanoes. The vine also flourishes well in primitive
countries, and especially among the debris of granite rocks: thus
the celebrated Hermitage wine is made from a foil of this
description.

The same climate, soil, and mode of culture, however,
often produce wines of very different qualities. Position and
aspect alone, all other circumstances being the same, make
a prodigious difference. The same vineyard, for example,
according as its different parts have a northern or southern
aspect, will produce wines of opposite characters, as will
also the same hill, at its top, middle, and bottom. The
aspect most favourable for a vineyard is upon a rising
ground or hill facing the south-east, and the situation should
not be too confined:

"Bacchus amat colles." apertos

If the soil be not favourable for the vine no art can make
it fo. Manure of different forts will indeed render the fruit
more abundant, but the wine will suffer in quality. The
belt manure is flated to be the dung of pigeons or poultry.
Burnt sea-wrack also is a favourite manure with some. Fat
and putrid manures are absolutely to be rejected, as they
destroy the wine altogether, by vitiating its flavour.

The qualities of wines are very much affected by the sea-
sons. In cloudy and wet seasons the wine is always inferior.

Rain is most to be dreaded at the season of the vintage.
Moderate rains just after the season of bloom are of great
advantage, and cause the fruit to swell very rapidly. Rough
winds are very prejudicial to vineyards. Mills are still more
so, especially during the season of bloom, as they are apt to
deflower the flower, and consequently the fruit: the reason of
this is perhaps not very evident, but it seems to depend in
part upon the rapid evaporation of the moisture left by the
fogs, when the sun breaks through them, and the great and
sudden change of temperature which takes place in con-
fsequence. Too great a degree of heat is injurious to the
wine; the perfection of their fruit, as well observed by Chaptal,
depends upon a due equilibrium between the quantity of
water affording aliment to the plant, and the degree of heat
necessary to elaborate this water into its juices.

Towards the northern limits of the vine country, the
plants are always supported on poles, and in cold and wet
seasons they sometimes slip off the leaves, or twist the flanks
of the clusters, in order to suppress vegetation and facilitate
the ripening of the grapes. The latter practice was not
unknown to the ancients: "Ut dulcia praeterea ferent,
afervant ab usus dulius in vitæ, pediculo intorto." Pliny.

But in warmer climates, on the contrary, the earth requires to be
sheltered from the heat, and here the vine is generally left to
spread over the ground, and thus by its foliage to protect the
foil, as well as its fruit, from the direct rays of the
sun. With respect to the best methods of pruning and training
wines, see the articles VINE, and VITIS.

Of the Vintage.—It is of the utmost importance in the
manufacture of wines, to attend to the precise moment when
the grapes have arrived at their full maturity; and then, and
not before, ought the vintage in general to commence. This
may be known, according to Chaptal, by the following
signs:

1. The green end of the cluster becomes brown.
2. The cluster becomes pendant.
3. The seed loses its hardness, and the skin becomes thin
and transparent.
4. The cluster and seeds are easily detached.
5. The juice is sweet, bland, thick, and clammy.
6. The kernels of the seeds are free from glutinous
matter.

The fall of the leaves denotes rather the approach of win-
ter than the maturity of the fruit, especially in the more
northern climates. This therefore is a fallacious sign. Ne-
vertheless, when the frost has been so severe as to destroy
the leaves, it will seldom be proper to delay the vintage much
longer, as the fruit can hardly be expected after this to be-
come ripe; and by delay it may stand a chance of being
spoiled entirely.

On the contrary, in the manufacture of particular wines,
the grapes are permitted to remain till they wither, or they

are
WINE.

are gathered and dried in the sun. Thus the celebrated Tokay wine is made of dried fruit, as are also many of the luscious wines of Italy. Some of the French wines likewise are made with fruit that has been suffered to ripen and wither upon the vines.

It is desirable in general that the weather should be settled, and the soil and fruit dry during the vintage. It is therefore recommended to abstain from gathering till the sun has dispersed the dew. As a general rule, this is proper; but in Champagne they commence gathering the fruit before the sun is risen, and cease their labours about nine o'clock, unless there be a fog, when they continue to gather all day. In these means they improve the whiteness and briskness of their wine, which are the qualities that chiefly render them celebrated. They also increase their quantity. Thus it is found in Champagne, that they gain a ton in every twenty-four where they collect the fruit moist with dew, and a great deal more if there happens to be a fog.

When the fruit is ripe, a proper number of experienced hands should be procured, so as to be able, in a single day, to fill the fermenting tub or vat, in order to ensure an uniform degree of fermentation. Women are commonly employed for the purpose, but the presence of an intelligent male overseer is absolutely necessary. In some parts of France the fruit is separated with scissors; in others with the nail; and in Champagne they use a knife. The scissors are undoubtedly preferable, as it does not shake the flock. The ripe fruit only should be collected, if the object be to make good wine, and what is unripe or decayed should be carefully rejected; indeed they have always two or three separate vintages in those countries, where they are careful of the quality of their wines; and the wine made first is always considered the best. In those parts, on the contrary, where the wine is chiefly distilled, as in Languedoc and Provence, they usually collect all the fruit indiscriminately at one time. In some districts, where the finest wines are made, as in Bourdeaux, &c. the fruit is carefully picked, and only the prime of the clusters taken. On the contrary, they carefully avoid having the fruit too ripe in Champagne, and other districts where sparkling wines are chiefly manufactured, and prefer the presence of a certain proportion of unripe fruit. It need scarcely be remarked, that the greatest care should be taken to prevent the fruit from being bruised or otherwise damaged.

The next important step is the management of the fruit after it has been collected. In different countries different preliminary steps are purposed before the fruit is submitted tou pressure. Thus in Spain, especially in the neighbourhood of St. Lucar, they leave the fruit exposed for two days to the rays of the sun. In Lorraine, part of Italy, in Calabria, and the island of Cyprus, as before observed, they dry the fruit completely, and it is the case in the manufacture of all the rich white wines.

A question that has been much agitated is, whether it be advantageous to strip the grapes from the stalks and remove the latter, or suffer them to remain. Both these methods have their advocates; but Chaptal remarks very properly that neither ought to be followed exclusively. It is true, the same celebrated chemist observes, that the leaves have a rough and unpleasant taste; but this appears to be of advantage to some wines, especially those made in the more northern districts, where the flight of the birds is so habituated by the leaves corrects their indigestibility, and appears to have the property of making them keep better, perhaps by rendering the fermentation more complete. In the neighbourhood of Bourdeaux, indeed, they remove the stalks from the red grapes in the manufacturing of their best wines, but they modify that part of the process in some degree according to the ripeness of the fruit: when the fruit is unripe, or has been injured by the frost, they remove nearly the whole of the stalks, but if the fruit be over-ripe they leave a very large proportion of them. A certain portion, however, is always permitted to remain with the view of facilitating the fermentative process, and rendering it more perfect. From the white grapes, the stalks are never removed. In short, in the colder districts, where the wines are of an inferior quality, or where the object is to render the wines as strong as possible, with the view of distilling them, the items in general do not require to be removed; but in warmer countries, where the finer-flavoured and richer wines are manufactured, every thing liable to affect these desirable qualities is to be carefully removed, and the items among the lees. The items are separated in various ways: sometimes by agitating the grapes in the vessels in which they are deposited with three-pronged forks, sometimes by coarse sieves made of oziers, &c.

The next important step is bruising the fruit, which is generally performed by treading them with the feet in perforated tubs or vessels placed over the vat or tub defined to receive the must. This mode of bruising grapes, though as ancient perhaps as wine-making itself, is very imperfect, as a great deal of the fruit remains unbroken. In England we should adopt the use of machinery.

Of Fermentation, the Circumstances affecting it, Phenomena, Products, &c.—The juice, or must, as it is termed, is no sooner in the vat than it usually begins to ferment. The vat is a capacious vessel made of wood or sometimes of mahogany, and its size corresponds, or ought to correspond, with the quantity of wine to be made. Before it is used, it requires to be thoroughly washed, and its sides in France are usually covered with lime, which has the effect of saturating a portion of the malic and other acids which exist in abundance in the must.

The fermentative process has been already described (see Fermentation); we shall therefore be very brief upon the subject here, and confine our attention principally to a concise recapitulation of the particulars, in order to present our readers with a general and connected view of the art of wine-making.

The vinous fermentation is influenced by several circumstances, such as temperature, presence of the air, the volume of the must, &c. The must of the grape requires a temperature of at least 55°, to enable it to commence the fermentative process. Some have denied that the presence of the air is necessary to fermentation. The recent experiments of Gay Lussac, however, seem to prove the reverse. This celebrated chemist found that the must would not begin to ferment in cloche vessels, but that the introduction of a little oxygen instantly set it going; the oxygen being first rapidly absorbed. Perhaps we may explain the opposite conclusions of different experimentalists upon this subject, by supposing that the presence of oxygen, though necessary to enable the must to commence fermentation, is not necessary to support it afterwards. The fermentative process is much influenced by the bulk or quantity of the must. It is a well-established fact, that the greater the quantity the more violent is the fermentation. An experienced manufacturer of wine, therefore, will take care to proportion the quantity of must to the qualities of his fruit, or rather perhaps to those of the wine which it is his object to procure; the sweeter and more luscious the must, the greater the quantity in general, which it will be proper to submit to the fermentative process in one mas.

Other important circumstances which influence the fermentative processes are the requisite quantities and due relative proportions
proportions to one another of the necessary principles. The
faccharine and fermentative principles, tartar and water, are
the principles (as explained under the article Fermentation)
essential to the production of wine. The sweetest grapes do
not always make the best wine, nor actually contain the
greater proportion of sugar, at least of real sugar, such as
is proper for the formation of alcohol. An experienced
taste, it is said, can readily distinguish between a really fac-
charine grape and a sweet grape; and consequently pronounce
priori whether it is adapted for making good wine or not.
Pure faccharine matter, however, will not ferment alone,
but requires a certain proportion of other principles to put
it in motion. When the must contains too large a proportion
of water, the fermentative processes is feeble, and the wine is
consequently bad. The ancients obviated this, as we before
mentioned, by boiling the must; a practice still sometimes
followed in the northern districts, especially in wet seasons.
The same object is gained also by drying the fruit; and
sometimes by the introduction of lime into the vat. The
juice of the grape always contains a certain proportion
of tartar. This quantity is greater in general as the quantity
of sugar is less. If the juice contains too large a propor-
tion of sugar in relation to the tartar, it is customary to add
a portion of the latter principle. On the contrary, if the
faccharine principle be deficient and the tartar in excess,
sugar is to be added.

The fermentative process is accompanied by the produc-
tion of heat, by the disengagement of carbonic acid gas,
and the formation of alcohol. These phenomena have been
already discussed under the article above alluded to. An-
other important circumstance, however, which takes place
during this process, is the colouring of the must. The
juice of the black grape, as well as of the white, is nearly
colourless; and if the fermentation be not permitted to take
place in contact with the hulks or marc, a colourless wine
is obtained in all cases. The colour of red wines is derived
from the marc, by permitting the wine to ferment in contact
with it; the colouring principle of the marc or hulks being
soluble in alcohol. Hence, when alcohol begins to be de-
developed by the fermentative processes, it acts upon the colour-
ing principle and dissolves it, and the must becomes coloured.
The following are the principal facts connected with this part
of the subject. The wine is more coloured the longer the
fermentative process is continued, and vice versa. The wine
is more coloured in proportion as the fruit is more ripe and
leaves watery. Wine obtained by pressure is more coloured
than other wine, and lastly wines manufactured in the south
are in general deeper coloured than those produced in more
northern districts.

Great attention and practical knowledge are required in
managing the fermentation properly, as on this important
process depend entirely the future qualities of the wines.
The same fruit in different seasons, and from various causés,
requires to be managed differently; and almost every kind of
wine requires a different, and, in some cases, even an
opposite, mode of treatment. Thus the fine bouquet of Bur-
gundy is completely dissipated by a too violent or falting
fermentation; while, on the contrary, the fermentation of the
strong wines of Languedoc, celebrated chiefly for the quan-
tity of alcohol which they contain, ought to be long and
complete. In Champagne, as we formerly mentioned, they
collect the fruit defined to form their white wines while moist
with dew or mists: on the contrary, in the manufacture of their
red wines, they prefer fruit as dry as possible. In the
former case, the fermentative processes is fo languid, as often
to require a gentle heat; in the latter, fo violent, as to require
to be moderated. Weak wines ought in general to be fer-
mented in casks; strong wines in the vat. No general rules,
however, can be given that will apply in all instances; but
the processes must be varied according to circumstances, and
the judgment of the manufacturer.

The fermentative process, for obvious reasons, is most
difficult to manage in the northern districts, where the fruit
is more imperfect. To encourage the processes, they some-
times introduce a little warm mullet to the bottom of the vat
by means of a long funnel. They also agitate it frequently,
and to preserve a due degree of temperature, cover the vat
with blankets, or heat the room artificially.

The theory or rationale of the fermentative processes has
been explained, as far as it is known, under the article Fer-
mentation, before alluded to; we shall therefore pass it over
entirely here, and confine our attention to practical points
only.

A most material point in the manufacture of wines is to
know the precise moment when the fermentative processes
has been carried far enough, and the means necessary to prevent
its getting farther than this point. In the wine countries al-
mast every manufacturer boasls of his knowledge in these
particulars, and often adopts different methods. Chapter
lays down the following rules to be attended to:

1. The wine ought to ferment so much the less time as it
contains less faccharine matter. Thus the light wines of
Burgundy require to ferment no longer than from six to
twelve hours.

2. The must ought to ferment a less time in the vat when it
is intended to retain the carbonic acid gas, and make sparkling
wines. In this case, the must is seldom left longer in the vat
than twenty-four hours before it is put into casks; and fre-
cently it is introduced into the casks as soon as it is sepa-
rated from the fruit; by these means the fermentation is
checked, and the carbonic acid gas prevented from escaping.

3. The fermentation ought to be of shorter duration, in propor-
tion as it is the object to obtain wines more free from colour.
This should be, therefore, particularly attended to in the ma-
ufacture of those wines where the absence of colour is an
effential requisite.

4. The fermentative processes is more active in warm wea-
ter, and when the must is large, &c. than under the oppo-
ite circumstances; and therefore, ceteris paribus, is sooner
completed.

5. When the object is to preserve to the wine the original
perfumed flavour of the grape, the fermentation requires to
be checked sooner than under ordinary circumstances.

6. On the contrary, the fermentation requires to be con-
tinued longer in proportion as the must is more thick, and
the faccharine matter more abundant.

7. It will also require to be longer when the object is to
manufacture wines for distillation.

8. It will be longer in cold weather, and especially if the
fruit has been gathered on a very cold day.

9. Lastly, it will be longer in proportion as it is the ob-
ject to make a deeper coloured wine.

These principles readily kept in view will perhaps be suf-
cient, with a little practice, to enable any person of ordi-
nary knowledge and powers of observation to decide upon
the important points in question.

Great care is requisite in the preparation of the casks for
receiving the wine. When they are new, they will spoil its
flavour if not prevented. For this purpose, boiling-water,
holding salt in solution, is introduced into them, which is
frequently agitated, and permitted to remain in them a long
time. After this they are to be washed out with a portion
of boiling mullet in a state of fermentation, or sometimes with
a little wine, &c. If the casks are old but sweet, the top is
merely
merely taken out, and the tartar removed; they are then washed well with warm water. If the casks have acquired a bad odour, Chaptal recommends to commit them to the flames; for though it may be possible to cover in some degree their bad odours, yet they are very likely to re-appear and spoil the wine.

The vats being ready, the wine is introduced into them, for which purpose it is drawn off from the vat by a cock placed a few inches above the bottom into an open vat, from whence it is conveyed to the casks. That portion of the wine reticling immediately over the must is termed 

The head is then carefully removed, and the marc is subjected to repeated prefigure. The wine that thus far obtained is usually mixed with the rhi. That produced by the first prefigure is strongest; that obtained by the last is usually more harsh and coloured. Sometimes, however, when it is the object to make vinegar, the marc is pressed but once. At other times, they keep the wine obtained by all the different prefigures in separate casks. In Champagne they usually mix together the wines obtained by the different prefigures, though they are known by different names. The wines obtained without any prefigure, or a very light one, they call vin gris; those obtained by the first and second prefigure, ail de perdris; those by the third, win de taille, which are most coloured, though sufficiently agreeable.

The marc is employed in various ways in the different districts. Some submit it to distillation; others, especially in the vicinity of Montpellier, prepare verdigris from it; others vinegar. In some districts, they feed cattle with it; in others, they burn it for the sake of the potash it yields, &c.

Of the Management of the Wine in the Casks.—The wine receives its last degree of elaboration in the casks; this consists in a fort of fermentative processes, to which the name of insensible fermentation has been applied. Almost immediately after the wine is introduced into the casks, a scum begins to be formed upon its top, and escapes by the bung-hole, which at first requires to be covered lightly only with a leaf or tile. In proportion as the fermentation subdues, the mafs of wine diminishes in bulk; and they watch this cautiously, in order to supply its place from time to time with new wine, so as to keep the cask always full: this process is denominated in France ouiller, which may be rendered filling up. In some districts they fill up every day during the first month, every other day during the second, and every eight days afterwards, till the time of racking. This is the method they adopt with the wines of Hermitage. In Champagne they permit the vin gris to ferment in casks for ten or twelve days, and when the ebullition has ceased, they clofe the bung-hole, leaving, however, a smallfpigot-hole by its side, which is permitted to remain open for eight or ten days longer; after which they close this with a plug, in such a manner as to be able to open it at pleasure. When the bungs are introduced, they fill up every eighth day by the fpigot, for twenty-five days. After this every fiftenth day, for one or two months; and fmal1ly, every two months during the whole time the wine remains in the cellar. When the scum has been wet and unfavourable, and the wines want body, or when it has been dry and hot, and they are too rich, twenty-five days after they have been made, they roll the casks five or six times, in order to mix the grounds, and re-excite the fermentative processes, and this they repeat every eighth day for a month.

The fermentation of the Champagne wines, which are designed to be brisk and sparkling, is very long and tedious. It is generally understood that they will be sparkling, provided they are bottled any time between the vintage and the following May, and that the nearer the vintage the brisker they will be. It is, however, generally taken for granted, that they will be sufficiently sparkling if bottled about the middle of March. Wines begin to sparkle in about fix weeks after they have been bottled; tho' however, produced on mountains become sparkling sooner than others. Wines bottled in June and July will be very little sparkling, and quite full if bottled so late as October and November.

In Burgundy, after the fermentation has relaxed in the cask, they put in a bung pierced with a small hole, in which they introduce a plug that can be easily removed at pleasure, in order to suffer the gas that may be extricated to escape. In the district of Bourdeaux, they begin to fill up eight or ten days after the wine has been introduced into the cask. A month after this they introduce the bung, and fill up every eight days. At firfl they bung the casks loosely, and then fasten them down by degrees, without running any risk. The white wines are racked and sulphured in December, and these require much more care than the red wines, from their containing more sediment, and their being more liable to become ropy. The red wines are not racked till towards February or March, and as these are much more apt to become four than the white wines, they require to be kept in cooler cellars during the summer. There are some who, after the second racking, turn the casks fo as to place the bung on one side; and thus the caflcs being hermetically sealed from there being no loss, there is no need of filling up. They then rack off annually, at any time of the year they find it convenient.

Methods nearly similar are adopted in other wine countries; hence it will be needless to repeat them. We shall, however, give a short account of the methods followed in the manufacture of Port, Madeira, and Sherry, the most popular wines of this country.

In Oporto, the complete fermentation of the must takes place in the vat. The wine is then introduced into large tuns, capable of holding twenty-five pipes each; and at this stage the brandy is added according to the judgment of the manufacturer.

In Madeira, the second or insensible fermentation is carried on in casks, and the wine is racked from them at the end of three or four months, at which time a portion of the brandy is added. The remainder is referred to be mixed at the time of exportation.

In the manufacture of Sherry, the grapes are first lightly dried, and sprinkled with quick-line. They are then wetted with brandy on being introduced into the press, and a portion of brandy is added to the must before the fermentation commences. The subsequent processes consist in repeated rackings at intervals of a month or two, till March, brandy being added at each racking.

The object of racking the wines is to separate the dregs conflit of tartar, &c. deposited from the wine, and which, if left, are liable to render it four, by re-exciting from time to time the fermentation. The tendency to fermentation is counteracted by a process termed sulphuring, and the spontaneous separation of the dregs is rendered more complete by clarification, which see. See also fining and forfging.

The sulphuring of wines consists in impregnating them with the vapours of burning sulphur, or sulphurous acid, and is generally effected by burning sulphur-matches in the casks. (See matching.) These matches are made in different ways, aromatics being sometimes mixed with the sulphur; but the sulphur is the only useful and necessary ingredient.
Sometimes a wine highly impregnated with sulphurous acid is prepared, a little of which mixed with the rest anwers the purpose of burning matches in the cask. Other substanoes, according to Dr. Macculloch, answer the same purpose as sulphuring: namely, the black oxide of manganese, and particularly the sulphate of potash. A draught of which salt is sufficient for a pipe of wine, and is very effectual in counteracting the fermentative process. The theory of these processes is very obscure.

We have before observed that the mere racking of wines is not sufficient to render them pure, and various methods are adopted at the racking periods to render this operation more effectual, and these altogether constitute the process termed clarification.

Lord Bacon mentions a practice among the ancients of putting wine into vessels well flapped, and letting it down into the sea. That this practice is very ancient is manifest from the discourse of Plutarch (Quell. Nat. 27.) about the efficacy of cold upon must.

Different periods, as before-mentioned, are chosen in different districts for racking wines. Thus the wines of Hermitage are raked in March and September, those of Champagne about the middle of October, the middle of February, and the latter end of March. If possible, a serene and settled state of the atmosphere, and a dry and cold day, should be chosen for the purpose, as the wine is always turbid in damp close weather, and during the prevalence of foothery winds.

In racking wines, it is in general desirable to expose them as little as possible to the atmospheric air. In some districts, a syphon is employed for the purpose. In Champagne they use a fort of pump. Dr. Macculloch recommends that the wine should be transferred from one cask to another by means of a leather hose, and this method is undoubtedly preferable. For clarifying wines, a great variety of substances are employed. Finials and albumen either from eggs or blood are the most common; but gum, sallow, rice, milk, the shavings of beech-wood, gyppum, and, &c. are used in different wine countries. An ounce of finials, or about eighteen or twenty whites of egg, are sufficient for one hundred gallons of wine.

Two very important circumstances in the practice of winemaking require yet to be mentioned; these are the medication of wines, and the means of remedying those defects to which they are liable.

The medication of wines consists in altering the colour, the flavour, or the strength of any given wine, or in mixing two or more together, as to produce a compound differing from, or superior to, either. It is difficult to give any general rules for this purpose, and the proper management of the processes depends chiefly upon the experience and taste of the maker.

It generally happens that when two wines are mixed, the fermentative proc is partially renewed, or the mixture is technically said to fret, whence the practice itself has derived the name of fretting in. Mixed wines appear to unite into one durable and homogeneous liquor, only in conformity of this fermentation. It is therefore desirable, if possible, to mix wines only at those periods when they both show a tendency to fretting, which, according to Chaptal, in the wine countries, appears to be at three principal feasons of the year, viz. when the wines begin to shoot, when they are in flower, and when the fruit begins to acquire colour. The wines being then proportioned according to the fancy or experience of the maker, a strong fermentation is excited, which is still farther assisted by agitation. The wine thus becomes homogeneous, and shews no more tendency to far-
WINE.

Strong wines, for obvious reasons, seldom become pure. When acidity is present only in a very slight degree, it may be palliated considerably by sugar, or by the addition of must concentrated by boiling. It is obvious, however, that the acid can only be got rid of by neutralizing or destroying it. For this purpose, the alkalis and alkaline earths have been employed, but they impart a disagreeable flavour to the wine. Of these substances, lime is the safest and best. It was formerly the practice to employ lead, in some form or other, for counteracting acidity in wines; but we know that this murderous practice has been long since laid aside. Rapiness is another diffece to which wines are liable. This occurs more particularly in those which contain a good deal of extractive matter. It may be much relieved, and sometimes cured, by exposing the bottles to the sun and air, by agitating and subsequently uncorking them, by adding a small quantity of vegetable acid, and by finning. The last diseace we shall notice is perhaps the most formidable of all, namely, a muffiness, or other ill-flavour communicated by the cask or cork. This appears to be, in general, absolutely incurable, though it may be sometimes diminished by agitating the wine in contact with the air, or by the introduction of common air or carbonic acid by pumping; Such is a summary account of wine-making from grapes, as practiced in the countries where that delicious fruit comes to perfection, and more especially in France. (See Birch's Hift. of the Royal Society, vol. i. p. 156.) We come now to consider,

2. The Manufacturing of Wines from other Fruits, or artificial Wines.—In the above sketch we have endeavored to present our readers with a general view of the principles of wine-making, at the same time that we described the practice. These principles are equally applicable to the manufacture of wine from all sorts of fruit; we shall therefore take the present opportunity of briefly recapitulating them here, as they cannot be too strongly impressed upon the memory, and as they at the same time constitute the most appropriate introduction to the present section that occurs to us.

The juice of the grape consists of a large proportion of water, holding in solution certain proportions of saccharine matter, of the juice or fermenting principle, which appears to be a modification of the saccharine principle, of various acids, especially the tartaric and malic, and of various ill-defined extractive matters. These principles, left to themselves for a short time in a medium temperature, soon begin to act upon one another, and some of them at length undergo remarkable changes. This process is termed fermentation, and constitutes the grand principle of wine-making. When this process has begun to subside, it will be found that the greater portion of the saccharine principle has disappeared, and that its place is supplied by a corresponding portion of ardent spirit or alcohol. This is the most striking feature of the change that has taken place, but all the other principles of the juice or must appear to have undergone like-wise some change either in quality or quantity. In short, the sweet and crude juice of the grape is found to be converted into wine.

In this state, the wine is introduced into casks, where it undergoes further changes, and is matured by a modification of the fermentative processes, which has been called the infusible fermentation. This is a most important step in the processes of wine-making, as by different modes of management in this stage almost the whole of that infinite variety which exists among wines is produced. Here also it is that all foreign substances designed to impart flavour, &c. to wines are in general introduced with the greatest propriety. When the infusible fermentation has been carried to the point desired, it is checked by the processes of racking, sulphuring, clarification, &c.; and thus the wine is rendered capable of being preferred at any point or state we choose.

Let us now apply these principles to the manufacture of wines from other fruits.

We start upon the grounds that artificial wines are intended to be imitations of wines prepared from grapes. In the first place, therefore, we have to prepare a juice or must similar to the juice or must of the grape in its general composition. Now, no fruit whatever yields a juice sufficiently similar to that of the grape. In our northern climate more especially, the saccharine principle, which is the fundamental principle in wine-making, exists in very minute proportion in most fruits. It must be, therefore, supplied artificially. The tartaric acid, or rather tartar, which appears to be another essential principle in wine-making, is likewise wanting in most of our fruits. This, therefore, must be supplied. On the contrary, other principles, and particularly the malic acid, appear to exist in too large a proportion in most of our fruits, which, in their natural state, are better adapted for making cyders than wines. To get rid of the malic acid, and to prevent its deteriorating effects, as well as the deteriorating effects of other foreign principles, is difficult, or perhaps impossible; and this will doubtless always render artificial wines in general inferior to those of the grape, though very near approaches may be made by judicious management.

The practical mode of obviating these difficulties is to dilute the juice of the fruit to such a degree, that a given quantity of it when diluted shall contain no more of the malic acid, for example, than a given quantity of the juice of the grape; and, as before observed, to supply artificially the two grand principles, sugar and tartar, which are wanting. Having thus prepared an artificial must, as nearly resembling in its composition that of the grape as possible, the application of the other principles will be obvious, as we have nothing to do but to manage, in general, all the subsequent processes precisely as if we were operating upon the must of the grape. We shall now, therefore, descend from generals to particulars, and, after having made a few remarks upon our native fruits, endeavour to point out the modes in which the more important foreign wines may be best imitated by them.

Fancy or caprice has led to the formation of wine from an infinite variety of substances, and almost every good housewife has some favourite receipt for making wines from what nature never intended for the purpose. Such compounds hardly deserve the name of wine; we shall, therefore, principally confine our attention to fruits. The following are the domestic fruits most usually employed for the purpose:

- Gooseberry, and three varieties of currant.
- Strawberry, raspberry, blackberry, mulberry.
- Sloe, damson, elderberry.
- Quince, cherry.
- British grapes.

To them may be added the foreign fruits

- Raisins.
- Orange, lemon.

The gooseberry and currant are of all others the fruits most commonly employed for the fabrication of artificial wines; and, perhaps, upon the whole, they are best adapted for the purpose. When used in their green state, both gooseberry and currant may be made to form light bril
WINE.

Brisk wines, falling little short of Champagne. Ripe gooseberries are capable of making sweet or dry wines; but these are commonly ill-flavoured, particularly if the hulk has not been carefully excluded. Ripe currants, if properly managed, make much better wines than gooseberries. Thee fruits are much improved, according to Dr. Macculloch, by boiling previously to fermentation. This, he states, is particularly the case with the black currant, which, when thus managed, is capable of making a wine closely resembling some of the best of the sweet Cape wines.

The strawberry and raspberry are capable of making both dry and sweet wines of agreeable quality. As commonly managed, however, their peculiar flavour is dilipated in the process; hence, as Dr. Macculloch observes, little is gained by their use to compensate for their comparatively high price. A simple infusion of these fruits, in any flavourles currant wine during the period of insensible fermentation, will, with greater cheapness and certainty, ensure the production of their peculiar flavour. The blackberry and mulberry are capable of making coloured wines, if managed with that view: they are deficient, however, in the astringent principle; nevertheless, they may be occasionally employed with advantage when a particular object is to be gained.

The sloe and damson are so associated in qualities, that nearly the same results are obtained from both. Their juice is acid and astringent; and hence they are qualified only for making dry wines. By a due admixture of currants or elderberries with sloes or damsons, wines not much unlike the inferior kinds of port are often produced. The elderberry is capable of making an excellent red wine. Its cheapness also recommends it. It does not, indeed, possess any great degree of flavour, but it polishes no bad one, which is a negative property often of great importance in artificial wine-making.

The quince, from its analogy to the apple and pear, is better qualified for making a species of cyder than wine. The cherry produces a wine of no very peculiar character. If used, care should be taken not to bruise too many of the stones, otherwise a disagreeable bitter taste will be imparted to the wine.

Grapes of British growth are capable of making excellent sparkling and other wines, by the addition of sugar. Dr. Macculloch informs us, that he has succeeded in making wines from immature grapes and sugar so closely resembling Champagne, Grave, Rhenish, and Mofelle, that the best judges could not distinguish them from foreign wines. The grapes may be used in any state, however immature; when even but half grown and perfectly hard they succeed completely.

The cottagers in Sussex, says Dr. Macculloch, are in the habit of making wine, almost annually, from the produce of vines trained on the walls of their houses. Many individuals through various parts of the southern counties, and even as far north as Derbyshire, practice the same with success. But the experiment is well known to have been made or many years on a large scale, and with complete results, at Pain's-hill, by the Hon. Charles Hamilton, in a situation with respect to soil and exposure of which parallel instances are to be found throughout the country, and produced from land of no value whatever for the ordinary purposes of agriculture. That our ancestors made wine from the produce of their vineyards there can be no doubt, and Dr. M. justly remarks, that we can still make by far better wine from our grapes, even as produced at present, than om any other fruit whatever. Thence, therefore, are cordon seras for the cultivation of the vine, especially as, the fame gentleman observes, we might, with care, inure and domesticate to our climate many of the richer and more delicate varieties of southern latitudes. See VINE, and VARIETIES; under the list of which articles some interesting experiments on this subject are related.

Damsons are extensively used in this country for making domestic wines, and also for the fraudulent imitation and adulteration of foreign wines, although not a native fruit; therefore they deserve to be mentioned here. When properly managed, they are capable of making a pure and flavourles vinous fluid, well adapted for receiving any flavour which may be required, and thus of imitating many wines of foreign growth. See the close of this article.

The orange and lemon are likewise used for making domestic wines. Upon the whole, however, they are not very well adapted for the purpose, as they contain too much acid, and too little of the extractive and of the sweet or fermentative principle.

From what has been said of the manufacture of wine from grapes, our readers will observe, that different methods are pursued, according to the kind of wine which it is intended to make. Now these remarks are equally applicable to artificial wines, in the manufacture of which it is absolutely necessary that the maker should determine beforehand upon the kind of wine which it is his object to produce, and to modify his processes accordingly. We may, with Dr. Macculloch, consider wines as of four general descriptions: sweet wines; sparkling or effervescing wines; dry and light wines, analogous to hock, grave, and Rhenish, in which the saccharine principle is entirely decomposed during fermentation; and finally, dry and strong wines, as Madeira and sherry.

Those of the first and most simple class are the sweet wines, or those in which the fermentative process has been incomplete. It is to this class that by far the greater number of our artificial wines bear the greatest resemblance; a resemblance, says Dr. M., so general as to shew that few makers of this article possess sufficient knowledge of the art to enable themselves to steer clear of what may be firmly called the radical defect of domestic wines. Sweet wines may be made from almost any ripe fruits. Those most generally employed, however, are the gooseberry and currant. We shall suppose that we wish to make the quantity of ten gallons of sweet wine from one or other of these fruits. For this purpose, the following are the proportions and other circumstances to be attended to. Forty pounds of fruit are to be introduced in a clean and sufficiently capacious tub, in which it is to be bruised in successive portions, by a pressure sufficient to crush the berries without breaking the seeds, or if gooseberries be employed, without materially compremling the skins. Four gallons of water are then to be poured into the vessel, and the contents are to be carefully stirred and squeezed in the hand until the whole of the juice and pulp are separated from the solid matters. The materials are then to be permitted to remain at ref for a period of from fix to twenty-four hours, when they are to be strained through a coarse bag by as much force as can be conveniently applied to them. One gallon of fresh water may afterwards be passed through the marc, for the purpose of removing any soluble matter which may have remained confinmed. From thirty to forty pounds of sugar, according to the desired strength and sweetnefs of the wine, and about fix ounces of cream of tartar, or, what is better, crude tartar, are now to be dissolved in the juice thus procured, and the total bulk of the fluid made up with water, to the amount of ten gallons and a half.

The liquor thus obtained is the artificial must, which is equivalent
equivalent to the juice of the grape. It is now to be introduced into a tub of sufficient capacity, which is to be well covered, and placed in a temperature varying from 55° to 60°. Here it is to remain two or three days, more or less, according to the symptoms of fermentation which it may shew, and from this tub it is to be drawn off into the cellar, where the fermentative process is intended to be brought to the point desired. As the fermentative process proceeds the bulk of the liquor diminishes, and its place must be supplied from time to time by the superfluous portion of must made for the purpose, so as to keep the liquor always near the bung-hole. When the fermentation has subsided a little, the bung may be driven in, taking care, however, to leave a small hole open by its side, which may be stopped with a peg, and opened occasionally to give vent to any air that may be generated.

When the wine has arrived at the desired point of sweetness, &c. it must be racked and clarified in the manner described in the former part of this article; and these processes must be repeated, and the casks sulphured, if necessary, in order to prevent the fermentative process from proceeding farther. In general, however, one racking in the following December or January will be sufficient, after which it may be kept in the casks for any length of time, or it may be bottled without the usual precautions. A fine serene and cold day should be chosen for these operations. Sometimes the fermentative processes will stop before the wine has arrived at the desired point, in which case it may be commonly easily re-excited by raising the temperature, and shaking the casks; or, if these fail, by having recourse to the means formerly described for that purpose.

By attending to these general directions, sweet wines may be made from other fruits, care being taken to increase or diminish the quantity of sugar according to the natural sweetness of the fruit employed.

The second general description of wines comprehends the brisk or sparkling wines; which may be, at the same time, either sweet or comparatively dry. Our readers will recollect the methods adopted in Champagne, and other countries where they manufacture sparkling wines from the grape, and which are described in the former part of this article. Now these principles are to be held in view in the manufacture of artificial wines intended to possess similar properties. The fruits most generally employed for forming wines of this description, are the immature gooseberry and currant; sometimes also immature grapes, and even vine leaves are made use of for a similar purpose, but grapes are doubtless preferable when they can be procured. Wines of this description are more difficult to be made than the last, at least they require much more care. If gooseberries are employed, they must be gathered when they have nearly attained their full growth, but before they have shewn the least tendency to ripen. The variety of gooseberry is perhaps indifferent, but it will be advisable to avoid the use of those, which in their ripe state have the highest flavour. Dr. Macculloch recommends the green balsam among the best. Tho' which are unsound, as well as the remains of the blossom and footstalk, should be carefully removed. Forty pounds of this fruit, thirty pounds of fine white sugar, and about six ounces of tartar, are sufficient for making ten gallons of wine. All the preliminary processes are to be conducted precisely in the same manner as those above described for making sweet wines. The must, however, ought to remain in the fermenting tub for about twenty-four hours, or two days only, when it is to be transferred to the casks, and the processes of racking, &c. managed as before, except that the wooden peg or spike must be permanently tightened as soon as the danger of bursting the cask has subsided. The wine thus made may commonly remain during the winter in a cool cellar, as it is no longer necessary to excite the fermenting process. To ensure its fineness, however, it is a good practice to draw it towards the end of December into a fresh cask, so as to separate the lees; and if at this time it should prove too sweet, instead of decanting, it will be better to fill up the lees so as to renew the fermenting process, taking care also to increase the temperature at the same time. At whatever time the wine has been decanted, it is to be fined with finginglas in the usual manner. Sometimes it will be necessary to decant it a second and even a third time into a fresh cask. All these operations should take place, as formerly mentioned, in dry cool weather, and the wine must, at any rate, be finally bottled in March. If immature curants are employed, which are perhaps upon the whole preferable to gooseberries, the same proportion of fruit, sugar, and tartar, and the same modes of management, may be had recourse to; care being taken to separate carefully the stalks of the currants. If grapes be used for the purpose, they may be safely taken of different degrees of ripeness, it is necessary to attend to the selection of any particular variety. The same proportions of fruit and sugar will be proper as when gooseberries and currants are employed, but the tartar must be omitted. The hulks also may be permitted to ferment with the liquor in the vat. The subseque process is to precisely the same as that described above. An excellent wine of the present description may be made from the leaves and tendrils of the vine. About forty pounds of these, and twenty-five or thirty pounds of sugar, will be sufficient for ten gallons of wine. To prepare it, seven or eight gallons of boiling water are to be poured upon the leaves in a tub, and permitted to remain for twenty-four hours. The liquor being poured off, the leaves must be strongly pressed, and subseque washed with another gallon of water. The sugar and the remainder of the water are then to be added, and the fermentative process conducted precisely as before. The present class of wines, if the process has been successful, (which is not always the case,) is brisk, and precisely similar in their qualities (flavour excepted) to the wines of Champagne, with the strength of the best Sicily.

The third variety of wines is that of which hock, grave, and Rhenish may be taken as examples. In these the faccharine principle is entirely overcome by a complete fermentation, while their future change is prevented by a careful application of the processes laid down for the preservation of wines of this class. Makers of domestic wines have rarely, says Dr. Macculloch, succeeded in imitating these wines. The reasons obviously are, the great disproportion of the sugar to the subseque fermentation in the first instance; and that want of the after-management, the neglect of which soon configns these wines to the vinegar rank, if chance should even at a first have produced successes. In making these wines, the relative proportion of fruit and sugar in common use must be materially altered, and the fermentative processes be conducted in a very careful manner. The subseque processes also of racking, sulphuring, and fining, must be practiced with great avidity, in order to preserve these wines after we have succeeded in making them. Dr. Macculloch states, from his experience, that these wines may be successfully imitated, and that they constitute some of the very best of those which can be made from domestic fruit. The proportion of fruit (generally of immature fruit) to the sugar, in the manufacturing of sweet wines, must be the great. The bung must remain open, but the fluid within must not be allowed to escape, while, if the fermentation proceed
ceeds languidly, it must be accelerated by heat and agitation. If, when it is finished, the wine continues too sweet, it may be bunged down till the spring without racking or fining, when the fermentation must again be renewed. The renewal of the fermentation may also be effected by adding some fresh juice of the same fruit. At whatever time, and under whatever of these processes, it has become dry, it is to be carefully fined and racked into a pulped or calf, and bottled, after being once more carefully fined.

The fourth and last class of wines consists of those which are both dry in their quality, and strong in their nature; such are, Madeira, sherry, &c.; the theory of these, from what has been said, will be sufficiently apparent. With due attention to the fermentative processes, such wines may be made of the requisite degree of strength without brandy. By means of this, however, if managed as formerly directed, the operator has it always in his power to produce wines of any required degree of strength.

We need not here repeat the methods of imparting different flavours to domestic wines, or of correcting their faults, since they differ in no respect from those recommended to be adopted in the manufacture of wines from grapes, to which therefore we refer.

The following general remarks upon the fabrication of domestic wines, will not perhaps prove uninteresting to our readers.

The great radical defect in the manufacture of domestic wines, is using too small a proportion of fruit compared with the sugar employed. It is this circumstance chiefly which renders the fermentative processes incomplete, and thus imparts that sweet and mawkish taste to our domestic wines, which renders them intolerable to many people, and even to all, perhaps, without the addition of brandy. The proportions of fruit and sugar given above may be considered as mean standards, which may be varied either way, according to circumstances and the nature of the wine intended to be produced. A very superior class of fruit wines may be manufactured by using the juices of our different fruits, either alone or very slightly diluted with water.

We mentioned that some fruits, and especially the black currant, were much improved by boiling. For this purpose, it will be sufficient that the fruit be finely boiled into the boiling point, before using it, the water in the vessel being so managed as to avoid any risk in burning. The black currant thus treated, and subsequently managed upon the principles which we have endeavoured to lay down, is capable of making a wine very nearly resembling some of the best sweet Cape wines.

The fermentative processes being rendered tardy and incomplete, by the improper adjustment of the sugar to the fruit, is frequently endeavoured to be excited by yeast; nothing can be more injurious than this. Yeast invariably spoils wines, by imparting to them a flavour that nothing will ever overcome. The only ferment to be employed in wine-making, is that furnished by nature; and when this is defective, as is sometimes the case in our domestic fruits, the ferment of the grape must be supplied artificially. This may be done by introducing a certain proportion of crude tartar, the dose of which may vary from one to five per cent. without materially affecting the wine, as a great proportion of what escapes decomposition will be subsequently depoited. All fruits, except the grape, will require more or less of tartar.

The last circumstance we shall notice is the introduction of brandy, or other spirit, into domestic wines. As commonly manufactured, they often require, as we have just stated, this addition to render them tolerable. We truly, however, that from the attention that has been lately paid to the subject of artificial wines, the modes of manufacturing them will be better understood, and that this will no longer be the case. Fine wines are invariably spoiled by the addition of ardent spirit, which seems to have the effect of slowly decomposing them, and thus of destroying that delicate, lively, and brisk flavour, so eminently possessed by all natural wines. Hence it is seldom or never used in wine countries; or rather it is confined to the manufacture of those wines defined for this country, where only this barbarous practice is tolerated. We again repeat, that if the fruit and sugar be duly adjusted to one another, and the fermentative processes be properly managed, an infinitely better wine will be produced without the use of brandy, than can ever be produced with it.

General Chemical Properties and Composition of Wines.—

The juice of the grape, as we formerly mentioned, consists of a large proportion of water, of certain proportions of the saccharine and fermentative principles, of various acids, especially the tartaric, and some ill-defined extractive principles. These were at first during the fermentative processes to undergo different remarkable changes, one of the most important of which is the conversion of the saccharine principle into alcohol. The nature of the other changes are not so well understood, nor does the little we know at present of the composition of wines throw any very satisfactory light upon the subject. One principle indeed, viz. the fermentative principle, does not exist in perfect wines, and therefore must be decomposed or separated during the process of fermentation. The principles formed in wines may perhaps be arranged under the four following heads: 1. Acids; 2. Extractive and colouring matters; 3. Essential oils; and 4. Alcohol. Water is not mentioned, because it forms the basis of all potable fluids, and consequently of wines.

1. Acids.—All acids have the property of reddening turnfole or litmus papers, and therefore contain more or less of a free acid. The acids found in wines are, the tartaric, the malic, the citric, the carbonic, and occasionally the acetic.

The tartaric acid, in combination with potash, or tartar, as it is usually termed, exists in great abundance in the juice of grapes, as formerly stated, and appears to be one of its most important ingredients. A large proportion of this tartar is double; is decomposed during the fermentative processes, and a considerable quantity of what remains is subsequently deposited in the casks or vessels in which the wine is kept, confinituting what is termed the craf. It appears probable, however, that the whole is not separated, and consequently, as Dr. Thomson judiciously remarks, that wines are never entirely deftitute of tartar. Satisfactory experiments, however, upon an extensive scale, are at present wanting upon this part of the subject. The malic acid, according to the experiments of Chaptal, exists in the greatest number of wines, if not in all, and that in much greater proportion than any other acid. If this be really the case, it is probably, in part at least, a product of fermentation, for the juice of grapes appears to contain very little of this acid. Traces of the citric acid were found by Chaptal to exist in some wines. This acid also exists in the juice of the grape, but in small quantity. All wines that have the property of effervescing, or sparkling, when poured from the bottle into a glass, contain carbonic acid. Champagne, for example, owes its characteristic properties to this acid. Sparkling wines are usually weak, and contain less alcohol than usual, for reasons that have been already explained. The acetic acid is not an essential ingredient of wine, nor in fact ought it ever to exist in it.
WINE.

the fermentation, however, be permitted to go too far, this acid will be formed, and hence it occasionally occurs in inferior wines.

2. Extractive and colouring Matters.—These ill-defined substances exist more or less in all wines. Their properties, however, are not well ascertained, nor are they probably uniformly the same in every instance. They have a tendency to separate spontaneously, and along with the tartar form what is termed the crust; hence, as wines become older, from their containing less of these matters, they usually become paler. These extractive matters may be also separated artificially by means of animal charcoal, the subacetate of lead, and even partially in some instances by lime-water, or the heat of the sun. The colouring matter, as we formerly noticed, is not derived from the juice of the grape, but from its husk.

3. Essential Oils.—Wines, though essentially the same in their general composition, are distinguished from one another principally by their flavour and odour, no less than by the proportion of alcohol they may contain. Now their sensible properties evidently depend upon some volatile and fugacious principle, which has been considered to be analogous to an essential oil. This principle is sometimes derived immediately from the fruit, as, for example, in the wines made from the Frontignac and Mufcat grape. At other times, it is the product of fermentation. Thus the finer flavours of claret, hermitage, and Burgundy, bear no resemblance to those of the grapes, from whence they are formed. Very often, as before stated, the principles of odour and flavour are communicated to wines artificially, by the introduction of foreign ingredients, as orris-root, grape, and elder-flowers, mignonette, &c. The menilium of this volatile principle is doubtless, in most instances, the alcohol contained in wines; but its quantity is so minute as to be incapable of separation.

4. Alcohol.—The characteristic ingredient of wines is alcohol. Indeed, wines may be considered as more or less dilute solutions of alcohol, impregnated with different flavouring substances, and a little acid. There have been great differences of opinion in what state alcohol exists in wines. Some chemists maintain, that alcohol does not exist ready formed in wines, but that its elements only exist in a peculiar state, and that their union is determined, and consequently alcohol formed, by the act of distillation. This opinion was advanced by Fabroni, and seems to have been adopted by some subsequent writers. Mr. Brande, however, has shewn by very decisive experiments, that all wines contain alcohol ready formed, and that this fluid is merely separated during the distillation of these liquors; and his experiments have been since fully confirmed by Gay Lussac.

The following Table, representing the Quantity of Alcohol and other Principles in different Wines, is taken from Dr. Thomson's Chemistry, though it was compiled originally by Neumann. The results are not absolutely to be relied upon, as the state of chemical Knowledge, at the time Neumann wrote, was very imperfect.

<table>
<thead>
<tr>
<th>A Quart of contains</th>
<th>Highly rectified Spirit</th>
<th>Thick, oily, unctuous, resinous Matter</th>
<th>Gummy and tartaceous Matter</th>
<th>Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aland</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alican</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Burgundy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carcassone</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Champagne</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>French</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Frontignac</td>
<td></td>
<td></td>
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<tr>
<td>Vin de Grave</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Hermitage</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Madeira</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Malmsey</td>
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<td></td>
</tr>
<tr>
<td>Vino de monte Pulciango</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Mofelle</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Muscadine</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neuchatel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Palm fer</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pontac</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Old Rhenish</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Rhenish</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Salamanca</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sherry</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spanish</td>
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</tr>
<tr>
<td>Vino Tinto</td>
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</tr>
<tr>
<td>Tokay</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Tyrol red wine</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Red wine</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
WINE.

The following Table has been given by Mr. Brande, representing the quantity by measure of alcohol, sp. gr. .825, contained in different wines, and other fermented liquors. The wines were all genuine.

<table>
<thead>
<tr>
<th>Wine</th>
<th>Proportion of Spirit per Cent. by Measure</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Liffa lady</td>
<td>26.47</td>
<td></td>
</tr>
<tr>
<td>Ditto</td>
<td>24.35</td>
<td></td>
</tr>
<tr>
<td>Ditto</td>
<td>25.47</td>
<td></td>
</tr>
<tr>
<td>Ditto</td>
<td>26.40</td>
<td></td>
</tr>
<tr>
<td>Ditto</td>
<td>25.77</td>
<td></td>
</tr>
<tr>
<td>Ditto</td>
<td>23.00</td>
<td></td>
</tr>
<tr>
<td>Ditto</td>
<td>25.12</td>
<td></td>
</tr>
<tr>
<td>Ditto (old in cask)</td>
<td>23.05</td>
<td></td>
</tr>
<tr>
<td>Ditto</td>
<td>25.09</td>
<td></td>
</tr>
<tr>
<td>Ditto</td>
<td>25.83</td>
<td></td>
</tr>
<tr>
<td>Ditto</td>
<td>24.29</td>
<td></td>
</tr>
<tr>
<td>Ditto</td>
<td>23.71</td>
<td></td>
</tr>
<tr>
<td>Ditto</td>
<td>22.30</td>
<td></td>
</tr>
<tr>
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<td>22.40</td>
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</tr>
<tr>
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</tr>
<tr>
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<td>24.42</td>
<td></td>
</tr>
<tr>
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<td>23.93</td>
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</tr>
<tr>
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<td></td>
</tr>
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<tr>
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<tr>
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<td>Ditto</td>
<td>19.83</td>
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<tr>
<td>Ditto</td>
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</tr>
<tr>
<td>Ditto</td>
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<tr>
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<tr>
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</tr>
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<td>Madeira (Sercial)</td>
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</tr>
<tr>
<td>Madeira (old in cask)</td>
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</tr>
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<td>Madeira (Sercial)</td>
<td>18.92</td>
<td></td>
</tr>
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<td>Madeira (old in cask)</td>
<td>18.94</td>
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</tr>
<tr>
<td>Madeira (Sercial)</td>
<td>20.51</td>
<td></td>
</tr>
<tr>
<td>Madeira (Sercial)</td>
<td>18.11</td>
<td></td>
</tr>
<tr>
<td>Madeira (Sercial)</td>
<td>19.20</td>
<td></td>
</tr>
<tr>
<td>Madeira (Sercial)</td>
<td>18.10</td>
<td></td>
</tr>
<tr>
<td>Madeira (Sercial)</td>
<td>18.65</td>
<td></td>
</tr>
<tr>
<td>Madeira (Sercial)</td>
<td>19.25</td>
<td></td>
</tr>
<tr>
<td>Madeira (Sercial)</td>
<td>17.26</td>
<td></td>
</tr>
<tr>
<td>Madeira (Sercial)</td>
<td>17.26</td>
<td></td>
</tr>
<tr>
<td>Madeira (Sercial)</td>
<td>17.43</td>
<td></td>
</tr>
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</tr>
<tr>
<td>Madeira (Sercial)</td>
<td>17.26</td>
<td></td>
</tr>
<tr>
<td>Madeira (Sercial)</td>
<td>18.13</td>
<td></td>
</tr>
<tr>
<td>Madeira (Sercial)</td>
<td>17.11</td>
<td></td>
</tr>
<tr>
<td>Madeira (Sercial)</td>
<td>16.32</td>
<td></td>
</tr>
<tr>
<td>Madeira (Sercial)</td>
<td>14.08</td>
<td></td>
</tr>
</tbody>
</table>

Other fermented Liquors.

<table>
<thead>
<tr>
<th>Wine</th>
<th>Proportion of Spirit per Cent. by Measure</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cyder, highest</td>
<td>9.87</td>
<td></td>
</tr>
<tr>
<td>Ditto</td>
<td>5.21</td>
<td></td>
</tr>
<tr>
<td>2. Perry, average</td>
<td>7.26</td>
<td></td>
</tr>
<tr>
<td>Ditto</td>
<td>7.26</td>
<td></td>
</tr>
<tr>
<td>3. Meat</td>
<td>7.32</td>
<td></td>
</tr>
<tr>
<td>Ditto</td>
<td>8.88</td>
<td></td>
</tr>
<tr>
<td>4. Ale (Burton)</td>
<td>6.20</td>
<td></td>
</tr>
<tr>
<td>Ditto</td>
<td>5.56</td>
<td></td>
</tr>
<tr>
<td>5. Brown stout</td>
<td>6.87</td>
<td></td>
</tr>
<tr>
<td>Ditto</td>
<td>6.80</td>
<td></td>
</tr>
<tr>
<td>6. London porter</td>
<td>1.28</td>
<td></td>
</tr>
<tr>
<td>Ditto</td>
<td>1.28</td>
<td></td>
</tr>
<tr>
<td>7. Brandy</td>
<td>53.39</td>
<td></td>
</tr>
<tr>
<td>Ditto</td>
<td>53.39</td>
<td></td>
</tr>
<tr>
<td>8. Rum</td>
<td>53.68</td>
<td></td>
</tr>
<tr>
<td>Ditto</td>
<td>51.60</td>
<td></td>
</tr>
<tr>
<td>9. Gin</td>
<td>54.32</td>
<td></td>
</tr>
<tr>
<td>Ditto</td>
<td>53.90</td>
<td></td>
</tr>
<tr>
<td>10. Scotch whiskey</td>
<td>56.00</td>
<td></td>
</tr>
<tr>
<td>Ditto</td>
<td>56.00</td>
<td></td>
</tr>
</tbody>
</table>

On the Uses of Wine in a Dietetic and Medicinal Point of View.—Mankind in every stage of civilization and society betray a propensity for fermented liquors. This indeed is so strongly marked, that some have been induced to consider it as the result of an instinctive faculty, and consequently have been led to suppose that fermented liquors are the proper and natural drink of the human race. Others, on the contrary, have contended that fermented liquors are of no real use to mankind, and are often even productive of much positive
positive evil, and hence have arrived at a conclusion diametrically opposite to the former. It is difficult to decide between these opinions. We confess, however, that we do not think it necessary, on the one hand, to have recourse to the supposition of an instinctive faculty to account for wine-drinking; nor, on the other, do we believe that the moderate use of natural wines is productive of any bad effects. The propensity for strong drinks seems explicable upon the general principle that all animals feel a pleasure in being satiety, or, as it were, crowding a greater portion of existence into a shorter space than natural; an effect in some degree produced by the exciting effects of such liquors.

As to the bad effects too frequently produced by fermented liquors, they may, in almost every instance, be fairly traced to the badness of their quality, or to an excess in quantity.

While, however, we do not object to the moderate use of what providence has so liberally bestowed upon us, no one can object more strongly than ourselves to its abuse. The melancholy effects of habitual intoxication are too well known to require particular description here. Severely does the victims of this degrading propensity suffer in mind, body, and fortune; nor are their sufferings confined to themselves, but entailed upon their ill-fated posterity. For proofs of these positions, we refer our readers to the articles Gout, Calculus, Apoplexy, Epilepsy, Insanity, &c. &c. in this work, where they will find these and other diseases justly ranked among the most painful and distressing to which humanity is liable, frequently ascribed to habitual intemperance as their cause.

But putting out of the question these effects of drunkenness, what a horrible picture of moral depravity does it present for a man to fit down deliberately, day after day, with the professed object of annihilating his intellectual faculties, and thus degrading himself below the level of the brute creation! And even supposing he has arrived at the enviable point of being able to swallow two or three bottles without losing his senses, and that this quantity has become necessary to his comfort, may even perhaps to his very existence, to what a wretched state of dependence has he reduced his bloated carcass! what a tax is such a being upon society, who, to prolong a loathsome existence, is obliged to consume daily in an unnecessary superfluity more than is sufficient to support a whole family for a week! See Drunkenness.

With respect to the operation of different wines upon the animal economy, they vary exceedingly according to their properties. New wines in general are unwholesome, and often prove purgative. Sweet wines are upon the whole perhaps the most wholesome, and, where the taste has not been previously vitiated, doubtless the most agreeable. Weak and acid wines are very apt to disagree with the stomach, especially when that organ has been accustomed to stronger wines. Hence an occasional debauch with such wines is notorious for inducing a fit of the gout, especially in this country, where the usual wines are immediately strong. The fame is true also, though perhaps in a somewhat less degree, with the effervescing wines. Red wines, in general, are of a more astringent and tonic nature than white wines, and commonly contain more spirit. There are, however, many exceptions to this rule.

It will be seen by consulting the above table, that port, Madeira, and sherry, the three wines in most common use in this country, contain from one-fourth to one-fifth of their bulk of alcohol. A person, therefore, who takes his bottle of wine every day, will thus take nearly half a pint of alcohol, or almost a pint of pure brandy! This at first sight will appear almost incredible, especially as the fame person would not perhaps be able to take a similar quantity of ardent spirit, either diluted with water, or in any other way. Some have concluded from this circumstance that the above experiments are not to be relied upon; but from the manner in which they were conducted there is no reason to doubt their general accuracy; the fact therefore remains to be explained. The most probable explanation is, that the alcohol in the wine is in some state of combination, which prevents its immediate action upon the stomach, and thus renders it liable to be digested or altered in its properties before it can exert its specific effects. The peculiar nature, however, of this state of combination is at present unknown. What renders this opinion the more probable is, that some bad wines, and especially domestic wines, which are often little better than mere mixtures of brandy and water, exert much more effect upon the animal economy than fine old wines, though they may not contain nearly so much spirit.

With respect to the medicinal uses of fermented liquors, when cordials are required, wines are by far the most efficient of the whole tribe, and of these port wine is perhaps the best. For full information on this subject, we refer our readers to the articles Fever, Gangrene, and Analogous Diseased of Deblity. See Chapal's excellent Essay on the Manufacture of Wines, Annales de Chimie, vol. xxxvi. and xxxviii. Dr. Macculloch's Essay on Wine-making. Mr. Brande's Essays in Phil. Trans. for 1811 and 1813, &c.

For the distillation of wines, see Distillation.

Wine, in France, is distinguishe'd from the several degrees and tinctures of its preparation, into

Merry-goutte, mother-drop; which is the virgin wine, or that which runs of itself out of a tap of the vat, in which the grapes are laid, before the vintage enters to tread, or stamp, the grapes.

Must, furmufl, or sum, is the wine, or liquor, in the vat, after the grapes have been trodden, or stamped.

Preefed Wine, Vin de Pressurage, is that squeezed with a press out of the grapes, when half-boiled by the treading. The husks left of the grapes are called corpo, mark, or more; by throwing water upon which, and preling them off, they make a liquor for servants' use, answerable to our eyker-gun, and called bofllan; which is also of some use in medicine, for the cure of disorders occasioned by vitiated humours.

Sweet Wine, Vin doux, is that which has not yet worked, or fermented. This is turbid, and has an agreeable and very saccharine taste. It is very laxative, when drunk too freely, or by persons disposed to diarrheas, it is apt to occasion these disorders. Its constipating is somewhat less fluid than that of water, and it becomes almost of a pitchy thickness when dried.

Boura, that which has been prevented working, by calling in cold water.

Cure, or worked wine, that which has been let work in the vat, to give it a colour.

Cuit, or boiled wine, that which has had a boiling before it worked; and which, by these means, still retains its native sweetness.

Paffe, or strained wine, a sort of raisin-wine, made by steeping dry grapes in water, and letting it ferment of itself.

Wines are also distinguished with regard to their colour, into white wine, red wine, claret wine, pale wine, rose or black.
black wine. And, with regard to their country, or the soil which produces them, into French wines, Spanish wines, Rhine wines, Hungarian wines, Greek wines, Canary wines, &c. And, more particularly, into Port wine, Madeira wine, Burgundy wine, Champagne wine, Falernian wine, Tokay wine, Schiraz or Sherry wine, &c.

Wines, again, are distinguished, with regard to their quality, into sweet wines, rough or dry wines, and rich or luscious wines, wines de liqueur; of which last some are exceedingly sweet, others sweet and poignant; and all chiefly used by way of a dram after meals, &c.

Such are French, Frontignac, Madeira, the Canary, the Hungary, Tokay, the Italian Montefalco, the Italian Schiraz, the Malvasy wines of Candia, Chio, Lefbos, Tenedos, and other islands of the Archipelago, which anciently belonged to the Greeks, but now to the Turks. These are sometimes called Greek wines, and sometimes Turkey wines.

The chief wines drank in Europe are as follow. 1. The Madeira island, and Palma, one of the Canaries, afford two kinds: the first called Madeira sec, the latter, which is the richest and best of the two, Canary or Palm sec. The name sec (corruptly written sack) signifies dry; those wines being made from half-dried grapes. There is another sort of sec wine, prepared about Xeres, in Spain, and hence called, according to our orthography, Sherry, or Sherry.

2. The wines of Candia and Greece are of common use in Italy. Malvasy was formerly the produce of those parts only, but is now brought chiefly from Spain: it is a sweet wine, of a golden or brownish-yellow colour, and to this is applied an Italian proverb, signifying, Manna to the mouth, and balbuzard to the brain. Almost all the wines used in the Venetian territories come from Greece and the Morea. 3. Italy produces the vino Greco, which is a gold-coloured unctionous wine, of a pungent sweetness, the growth of mount Vefuvius, but much sophificated by the Neapolitans. In the neighbourhood of mount Vesuvius is made the Morgagnierra wine, and a thick, blackish one, called Verragia; and at the foot of the hill the delicious vino vergine. The kingdom of Naples affords the Campania or Paulyfippo, Mufcatel, Salernitan, and other excellent wines, and also the Chiarello, much drank at Rome. But the principal is the red, fat, sweet, and grateful poignant one, called Lachryma Christi. 4. The Ecclesiastical State produces the bright, pleasent Albano, and the sweet Montefalco, a yellowish not very strong wine, resembling good Florence, &c. 5. In Tuscany are the excellent white and red Florence; the celebrated hot, strong, red wine, de Monte Puleiano, &c. 6. In Lombardy, the Monferrato and Montferrat are tolerable; between Nizza and Savona is produced an incomparable Muscadine. 7. Piedmont and part of Savoy have excellent light wines. 8. The Sicilian, Sar- dinian, and Corsican wines are also good. 9. Most of the Spanish wines are composed of fermented or half-fermented wine mixed with distilled must, and variously manufactured, or of an infusion of dry grapes in weak must. Of thes wines, there are a few in Germany, as the Alicante, which is a thick, strong, very sweet, and almost nauseous wine, Sherry, Spanish, Malmsey, &c. 10. In Portugal there is plenty of red Port, which is much drunk in England. The best Vino tinto, a blackish-red wine used by the coopers for colouring other wines, is said to be the produce of Portugal. This kingdom also deals largely in Madeira.

* 11. In France there is a great variety of wines; of which the strong, sweet, full-bodied, spiritual ones, are called Vins de liqueur. Languedoc and Provence afford the sweetest wines, and the same provinces, with Champagne and Burgundy, the strongest; the wines of the northern parts, as Picardy and Bourdeaux, are the worst, and those about the middle of the kingdom, as Paris and Orleans, of a middling kind. The most celebrated of the French wines are, Champagnes, Burgundy, Vino di dea, or partridge-eye, Frontignac, Hermitage, &c. 12. In Switzerland, the best wines are, the Neuhutlen, Valelle, Ladafo, and Reiff: the Valelle straw-wine, so called from the grapes being laid for some time upon straw before they are pressed, is particularly celebrated. 13. The dry-grape wines of the Upper Hungary are in general excellent, and much superior to those of the Lower. (See Tokay.) 14. Among the German wines, those of Tyrol are very delicate, but do not keep. 15. Of Austrian wines, those of K shimmer-Neuburg and Brodenberg are deemed the best; and there are also good wines in other parts of the Imperial dominions. 16. In the Peloponnisus, the best wine is that of Wurms, especially the fort called Women's Milk. 17. Among the more esteemed German wines may be reckoned also Rheins, Mayne, Moelle, Neckar, and Elfs: a certain writer calls the Rheins made in Hockheim (Hock) the prince of the wines of Germany.

Wine is also variously denominated, according to its state, circumstances, qualities, &c. e.g.

Natural Wine, is such as comes from the grape, without farther mixture, or sophification.

Brewed Wine, or Adulterated, is that in which some drug is added, to give it strength, fineness, flavour, briskness, sweetness, or some other quality which is wanted.

Pricked Wine, or Eager, is that turned four times.

An easy method of recovering pricked wines may be learned from the following experiment:—Take a bottle of red port that is pricked, add to it half an ounce of tartarized spirit of wine; shake the liquor well together, and let it by for a few days, and it will be found very remarkably altered for the better.

This experiment depends upon the useful doctrine of acids and alkalies. All perfect wines have naturally some aciidity, and when this acidity prevails too much, the wine is said to be pricked, which is truly a state of the wine tending to vinegar: but the introduction of a fine alkaline salt, such as that of tartar, imbibed by spirit of wine, has a direct power of taking off the aciidity, and the spirit of wine also contributes to this, as a great preservative in general of wines. If this operation be dexterously performed, pricked wines may be absolutely recovered by it, and remain saleable for some time: and the same method may be used to mul-tiquors just turned four. Shaw's Lectures, p. 214.

Flat Wine, is that fallen weak and vapid, for want of being drank in time.

Sulphured Wine, is that put in casks in which sulphur has been burnt; in order to fit it for keeping, or for carriage by sea.

Colour, is a thick wine, of a very deep colour, serving to dye the wines that are too pale, &c. as the black wine in use among vintners. See Wine fugros.

The method of converting white wines into red, so much practiced by the modern wine-coopers, is this: put four ounces of turtole rags into an earthen vessel, and pour upon them a pint of boiling water; cover the vessel clofe, and leave it to cool; strain off the liquor, which will be of a fine deep red, inclining to purple. A small proportion of this colour is a large quantity of wine. This tincture might be either made in brandy, or mixed with it, or else made into a syrup, with sugar for keeping. A common way with the wine-coopers is to infuse the rags cold in wine for a night or more, and then wring them out with their hands; but
but the inconveniency of this method is, that it gives the wine a disagreeable taste, or what is commonly called the taste of the rags, whence the wines, thus coloured, usually pass among judges, for prefled wines, which have all this taste from the canvas rags in which the lees are prefled.

The way of extracting this tincture, as here directed, is not attended with this inconvenience; but it loads the wine with water; and if made into a syrup, or mixed in brandy, it would load the wine with things not wanted, since the colour alone is required. Hence the colouring of wines has always its inconveniences. In those countries which do not afford the tinging grape, which affords a blood-red juice, whereas the wines of France are often stained, in defect of this, the juice of elderberries is used, and sometimes logwood is used at Oporto.

The colour, afforded by the method here proposed, gives wines the tinge of the Bourdeaux red, not the Port; whereas the foreign cooperers are often dillufed for want of a proper colouring for red wines in bad years. This might perhaps be supplied by an extract made by boiling flack-lack in water. The skins of tinged grapes might also be used, and the matter of the turniole procured in a solid form, not imbibed in rags. Shaw's Lectures, p. 211.

Chip Wine, is that poured on chips of beecho-wood, to fine or soften it.

Rape Wine, is that put in a cask half-full of fresh grapes picked for the purpose, to recover the strength, brillikens, &c. which it had loft by keeping, &c.

Burnt Wine, is that boiled up with sugar, and sometimes with a little spicer.

There is also a sort of Malmsey wine made by boiling of mufcadine.

Wines, Condensing of, a phrase used by Stahl, and some other writers, to express what is more usually called the concentrating of them, that is, the freeing of them from the superfluous humidity which they contain, and by these means rendering them more rich and noble, freeing them from their talettepre part, reducing them to a smaller bulk, and thus making them fitter for transportation, and finally rendering them more durable in their perfect state, and much more subject to the various accidents that make them decay. See Concentration.

Various methods have been attempted for the effecting of this, as by means of heat and evaporation, or by percolation, &c. and great objections found in the way of all of them, except the latter, brought into use by Stahl, and since recommended greatly to the world by Dr. Shaw in his Chemical Essays.

If any kind of wine, but particularly such as has never been adulterated, be, in a sufficient quantity, as that of a gallon or more, exposed to a sufficient degree of cold in frosty weather, or be put in any place where ice continues all the year, as in our ice-houses, and there suffered to freeze, the superfluous water that was originally contained in the wine will be frozen into ice, and will leave the proper and truly-efficient part of the wine unfrozen, unless the degree of cold should be very intense, or the wine but weak and poor. This is the principle on which Stahl founded his whole system of condensing wine by cold.

When the frost is moderate, the experiment has no difficulty, because not above a third or fourth part of the superfluous water will be frozen in a whole night; but if the cold be very intense, the best way is, at the end of a few hours, when a tolerable quantity of ice is formed, to pour out the remaining fluid liquor and set it in another vessel to freeze again by itself.

If the vessel, that thus by degrees receives the several parcels of the condensed wine, be suffered to stand in the cold freezing place where the operation is performed, the quantity lying thin in the pouring out, or otherwise, will be very apt to freeze anew, and if it be let in a warm place, some of this aqueous part thaws again, and so weakens the reft. The condenced wine, therefore, should be emptied in some place of moderate degree as to cold or heat, where neither the ice may diffuse, nor the viscous substance mixed among it be congealed. But the best expedient of all is to perform the operation with a large quantity of wine, or that of severall gollons, where the utmost exactness, or the danger of a trifling waft, needs not be regarded.

If the wine now once concentrated should, by a long continuance in the freezing cold, be again congealed to the utmost (unless the cold were very severe indeed), and then again be drained from its ice, there, soon after this, falls to the bottom of the vessel a pure white powar or tartar, and even the icy part afterwards deposits also a little of the same substance after thawing; and after standing two or three daies, there is always more and more of this tartar precipitated, and that constantly the more in proportion as the wine was more austere, or less adulterated with sugar, brandy, or the like; for these things contain no tartar.

The ice of the second operation on a quantity of wine differs in nothing from that of the first, provided only that the wine was poured clear off from it, before the ice is set to melt, by which means it diffolves into a clear phlegm. This shews the excellency of the operation; as it loses not its efficacy upon repetition, but brings away more water as well at last as at first, without robbing the wine of any of its genuine or truly valuable parts. The remaining unfrozen liquor is a real concentrated wine, as appears by its colour, consistence, taste, and smell, and is actually become a nobler and richer wine than could be procured without such a contrivance.

This operation, though it be perfect in regard to wine, yet does not succeed so well in regard to the malt-liquors. The experiment has been fairly tried by Stahl on a gallon of strong malt-drink, and the succefs was as follows:—The ice separated in the first operation, when thawed by heat, resolved into a liquor of the colour and taste of small-beer; and the second concentration afforded an ice of much the same kind, which might have passed for ordinary small-beer, but for a flashy watery taste that manifestly predominated in it. The liquor unfrozen was but a pint and a half by measure, but it was extremely rich and thick, and seemed very strong and spirituous, and perfectly aromatic, or highly flavoured. The consistence was something like that of a thin syrup, and it had a pleasing softness that sheathed the acrimony of the spirit, and covered the bitter taste of the hop.

The mucilaginous nature, which is predominant in all malt-liquors, occasions a great inaccuracy in this experiment, as not sufferiog the water to run clear, or be separated from the richer tincture of the malt, nor letting the condensed liquor be obtained clean from the ice; but as the losses occasioned by this is not great, and the liquor is much cheaper than wine, if this should ever come into use in the large way, the thawed liquor of the ice might be used again in a new brewing, and to the loss of that part of the strength which was carried away by the freezing be recovered.

Wines in general may by this method be reduced to any degree of vinosity or perfection. Thus, for example, if a wine of a moderate strength hath a third part of its water taken away, in form of ice, by congelation, the remaining part will thereby be doubled in strength and goodness: for if we allow, in the better sorts of wine, that one-third part, which
WINE.

which is near the truth, is truly good or vinous, and twothird parts are nothing but water, one-third part of the
good wine being blended among the two-third parts of
water, of no strength or value; it follows, that if one of
these third parts of water be taken away, and all the wine
left, that which was before but one-third wine, is now onehalf wine, no way reduced in its strength, and therefore the
whole must be stronger in that proportion.

But if this operation of congelation be carried to the
utmost, and be practised on a large quantity of wine, and
with a very intense cold, and the ice taken away several
times, and the wine, thus freed from a part of its water,
again and again exposed, it will be found that good wines
will be reduced to one-sixth part of their original quantity:
and the vitner will easily find out the use of this remaining
sixth part, which is a true quintuffice of wine, and will be
of the utmost benefit, by mixing it in small quantities with
poor and low-flavoured wines, to meliorate and improve
them; and even to convert the low-flavoured and leaft
valuable ones into thofe very wines from which this con-
denfcd part was procured.

This method is not practicable to advantage in the wine
countries alone. Dr. Shaw affirms us, that he has himself
experimented it here, and with the use of proper freezing
mixtures has reduced wines in England to a much smaller
quantity, in proportion to the whole, than in the Strongest
of Stahl's experiments. It is evident, that by how much
the quantity is smaller, by fo much it is richer and stronger,
provided that the operation has been properly performed.
The doctor affirms us, the noble effence or rob, thus pre-
pared, is capable of working almost miracles, by turning
water into wine, and the like; but that, in order to its suc-
ceeding well, there requires great care in the operator, when
the congelation is repeated the laft times. Shaw's Chem.

WINE, Clarification of. See Clarification, and Wine
supra.

WINE, Colouring of. See Wine Colour, and Wine
supra.

WINE, Fining of. See Fining, and Wine supra.

This operation is practised in Germany in the following
manner: they have in some vats three or four fioves, which
they heat very hot: others make fires almost before
every vat; by which means the muft is made to ferment
with great vehemence. When the ebullition, fermentation,
and working ceafe, they let the wine fland, and then rack
it. This fining is only used in cold years, when the wine
happens to be green.

WINE, Forcing of. See Forcing.

WINE, Domainie. See Wine supra.

In the Musewm Rufficum we have the following directions
for making raffin wine: put thirty gallons of hot water
into a vefsel at leaft one-third bigger than sufficient to
contain that quantity; and add to it one hundred weight of
Malaga raffins, grossly picked from their falks. Mix the
whole well together, and cover it partly with a linen cloth.
When it has flooded a little while in a warm place, it will
begin to ferment, and must be well flaired about twice, in
twenty-four hours, for twelve or fourteen days. When the
sweetnefs is nearly gone off, and the fermentation much
abated, which will be perceived by the subfiding and refl
of the raffins, strain off the fluid, marking it, firft by the
hand, and afterwards by a prefl, out of the raffins. Let
this liquor be put into a found wine-cafe, well dried and
warmed, adding eight pounds of Lisbon fugar, and a little
riffal, and referring part of the liquor to be added from
time to time, as the decline of the fermentation will give

room. In this ifate, the liquor must remain for a month,
with the buug-hole open; and having filled the vefsel with
the referved liquor, let it be closely flopped, and kept for
a year or longer, and then bottled off. At the end of a
year and a halt it may be drank, but will improve for four
or five years.

Some faving may be made in the expence, by diminishing
the quantity of raffins, and increasing that of the fugar, in
the proportion of four pounds of raffins for one of fugar;
or by diminishing the proportion of both raffins and fugar,
and adding clean malt-spirits, when the bung of the cafl is
closed up. Any other large raffins may be used, and the
Malaga; but the thinner the riffs and the sweeter the
pulp, the stronger will be the wine.

If this wine be perfectly fermented, and kept a long time,
so that no sweetnefs remain, it will resemble Madeira.

An artificial Frontignac may be made of this wine, in
which the proportion of fugar or of malt-spirits to the raffins
is large, and the whole body weaker: the mufcadel flavour
being communicated by an infusion of the flowers of mea-
dow-fweet. In the making of this artificial Frontignac, the
ferment should be flopped, by clofing the cafl and adding
the spirit, while a confiderable degree of sweetnefs remains,
and the wine may be drank after it has been a little while in
the bottles.

Cyprus wine may be imitated by the fame means, using
three or four pounds more of fugar than the quantity above
preferred, and stopping the fermentation while a confider-
able degree of sweetnefs remains.

Artificial Mountain may be made by preferring a small
degree of sweetnefs, giving the nut-like flavour, and keep-
ing the beft kind of the above wine to a due age. The
flavour may be obtained by the infusion of the Florentine
orris-root, powdered, with a very small proportion of orange
and lemon peel; and the wine may be rendered more dry or
sweet, by continuing the fermentation for a greater or lefs
time, and adding a corresponding proportion of clean malt-
spirits, when the fermentation is stopped sooner. The adding
of some of the flony feeds of the raffins well bruited will
give the nut-like flavour; and the putting in a part of the
flalks will add a sharpnefs, found generally in this kind of
wine.

The racy taste of Canary, commonly called fack, may be
counterfeited by the addition of a proper quantity of the
juice of white currant-berries to the wine, made with a large
proportion of fugar to the raffins, and left very fweet in the
fermentation. But it is faid that a spirit, diffilled from the
leaves of clary and clean malt-spirits, put to the wine, will
give it a very strong reneblance of fack. It is faid alfo,
that the juice of the bramble-berries, added to the mixture
of the wine, before the fermentation, will give both the
colour and flavour of clarat; but in this cafe the quantity of
raffins should be confiderably diminished, and that of the
fugar increafed, as the fermentation must be continued till
the sweetnefs be wholly deftroyed.

Wines of this kind fhould be kept at leaft a year before
they are drank. See Sweets.

WINE, Estemporaneous. A hundred weight of good
treacle will produce, according to the art of the ditillier,
from four to seven gallons of pure alcohol; that is, from
eight to fourteen gallons of the common-proof malaffs
spirit. The still-bottoms have many ufs. The ditillers
feal and recover their muldy cafls with them, and they
may be used for all thofe purpofes of cleaning where argol
is required. Mr. Boyle's acid spirit of wine, or a spirit
very like it, may also be procured from them, and a matter

Vol. XXXVIII.
WINE.

analogous to that Becher calls the media fubflanta vini. This liquor gives a durable extemporaneous wine.

WINE, Stooming of. See STOOMING.

Wines, Lees of, in Distillation, a term applied to the liquor which first comes over, when the waf has been subjected to di-

tillation, and which is concentrated by a second operation.

See DISTILLATION.

Wines, Medicinal or Medicated, in Pharmacy, a term ap-
plied to those preparations consisting of wine holding differ-
et active ingredients in solution. They were for-
merly very numerous, but at present their number is very limited. See VINOUM, under which article those at present in use are described.

Wine, Lees of, are the impurities of it, or the thick

dediment remaining at the bottom of the casks, when the

dew is drawn out. The distillation of wine-lees into spirit is conducted very

much in the same manner with that of the malt-wash, when

distilled with the meal part in it; the principal difference

is on this account, that the oil of the malt being very nau-

geous and disagreeable, the utmost care is to be used to keep

it back in all the processes of primary distillation, and of

rectification; whereas, on the other hand, the oil of the

wine-lees being a very agreeable and pleasant one, as much

care as possible is to be taken to bring it over with the spirit.

Glauber has written a peculiar treatise on this subject, in

which, without touching upon the most advantageous pro-
duction of all, he has proved the work to be so very profit-
able, that the whole usually passes for one of his wild flights,
rather than a solid business.

The method of distilling a liquid ley for its spirit is a

thing universally known, but the advantageous thing, on

this basis, is the distilling of a dry ley preseed and pre-

ferred, and the managing of the business in such a manner

as at first or last to procure and separate all its valuable

parts. The solid ley, here mentioned, is that usually sold

to the hatters in England, and is the same thing that in

France and other wine countries the vineyard-makers dispo-

e of in cakes, after they have preferred out all the wine, and which

was afterwards burnt, and makes what Lemery and others

call cőttris clovellati; and the English gravelled offes, a fixed

alkaline salt-like potash.

This ley, when used for distilling, should be that of the

French wines, and either such as is newly preseed, or has

been well secured by packing in a close manner in tight

casks, with some proper contrivance of dry land, or the

like, to keep its external surface from the contact of the

air, which is very apt to corrupt or putrefy it.

If this ley is intended to be kept many months, it will be

very proper to secure it by sprinkling the layers as they are

packed up with a little brandy. The expense of this is no-
thing, for the brandy is recovered again in the operation.

Shaw.

Wine, Oil of, a very precious liquid, kept as a secret in

the hands of some dealers in spirits, and used to give the

brandy flavour to spirits of less price. It is certain that all

the spirits we use take their flavour from the essential oil of the

substance they are made from; that of malt is very nau-
geous and offensive, and renders the spirit horribly disagree-
able, if not carefully kept back in the distillation of it; that

of the grape, on the other hand, is extremely agreeable, and is what gives the delicious flavour to French brandy;

this, therefore, is to be carefully brought over among the

spirits in distillation.

This is that oil of wine so much celebrated among our

distillers, and is for their use made separate, and is of such

effect, that half an ounce of it will determine a pure and
clear malt spirit to be French brandy, so as to stand the test

of the nicest palate, and all the trials that can be invented,

provided the oil and the spirit have both been carefully

made.

The manner of making the oil is this: they take some

cakes of dry wine-lees, such as are used by our hatters, and

dissolving them in six or eight times their weight of water,

distilling them in a slow fire, and separating the oil by the

separating pot, referring for this nice use only that which

comes over first, the oil that follows being coarser and

more refined. To render this business perfectly success-

ful, there must be several things observed: 1. The ley

must be of the right kind, that is, of the same nature with

the French brandy propose to be imitated. 2. The malt-

spirit must be extremely pure. 3. The dose of the oil must

be very well proportioned. And, 4. The whole must be

artificially united into one simple and homogenie liquor.

These cautions all regard only the tare, and besides these,
in order to come up to a nice counterfeit, several other par-
ticulars must be attended to; such as the colour, proof,

tenacity, softness, and the like; so that, in short, the opera-
tion has too much nicety in it to be hit off by every ordinary
dealer. When this fine oil of wine is procured, it may be

mixed into a quintessence, with pure distilled alcohol, or

the totally inflammable spirit of wine, to prevent its growing

difficult, rancid, or reinous; and thus it may be long

preferred in full possession of its flavour and virtues.

The still-bottoms, or remaining matter after the distilla-
tion of this oil, will yield many productions to advantage,

particularly tartar, and salt of tartar, as also an empy-

ematic oil, and a volatile salt, like that of animals. Some

kind of lees afford all these in much greater quantity than

others; the lees of Canary and Mountain wines yield very

little of them; and, indeed, scarce any tartar or fixed salt

at all; but the white French lees of those thin wines that

afford the ordinary brandies, yield them all very copiously,

so much that sometimes a single hoghead of dry and clos-

peed lees will afford, by this process, three gallons of

brandy, forty pounds of clean tartar, a large proportion of

empyreumatic oil, and volatile salt, besides full four pounds

of good salt of tartar. It is not to be expected, however,

that every parcel of this ley should yield fully in this pro-

portion. Shaw's Essay on Distillery.

Wine, Piece of. See PIECE.

Wine-Prijs, a machine contrived to squeeze the juice

out of grapes, and consisting of several pieces of timber,

variously disposed, which compose three bodies of timber-

work, closely united to the axis, which serves as a swingle,

by which it may be moved by the vice. Of these there are
different sizes as well as different contructions.

Wine, Prijsage. See PRIJSAGE.

Wine, Rackage of. See RACK, and WINE supra.

Wine, Spirit of. See SPIRIT.

Wine-Spirit, a term used by our distillers, and which may

seem to mean the same thing with the phrase spirit of

wine; but they are taken in very different senses in the

trade.

Spirit of wine is the name given to the common malt-

spirit, when reduced to an alcohol, or totally inflammable

state; but the phrase wine-spirit is used to express a

very clean and fine spirit, of the ordinary proof-strength,

and made in England from wines of foreign growth.

The way of producing it is by simple distillation; and it

is never rectified any higher than common bubble-proof.

The several wines of different natures, yield very different

proportions of spirit; but in general the strongest yield

one-fourth, the weakest in spirits one-eighth part of proof-

spirit;
spirit; that is, they contain from a sixteenth to an eighth part of their quantity of pure alcohol.

Wines that are a little moreserve not at all the worse for the
purposes of the distiller; they rather give a greater
vinosity to the produce. This vinosity is a thing of great
use in the wine-spirit, whose principal use is to mix
with another that is tartrarized, or with a malt-spirit, rendered
alkaline by the common method of rectification. All the
wine-spirits made in England, even those from the French
wines, appear very greatly different from the common
French brandy; and this has given our distillers a
notion that there is some secret art practised in France,
for giving the agreeable flavour to that spirit; but this
is without foundation.

When we distil Sicilian or Spanish wines, we do not
produce Sicilian or Spanish brandies; and the true reason
of this is, that the wines which they distil on the spot
into brandy, are very different from those which they
export as wines.

Those they distil are fo poor and thin, that they will not
keep many months, nor can possibly bear exportation.
If we had in England those poor wines they distilled into
brandy near Bourdeaux, Cognac, or up the Loire, there
is no doubt that the spirit we made from them would be
universally allowed to be French brandy. We have proof
of this from some of the Scotch distilleries, where they,
with no peculiar art, or secret method, procure from
some of the poor pricked and damaged wines received here,
brandy so nearly resembling that of France; that a
good judge will scarcely be able to make the distinction.
Wine-spirits and brandies, therefore, are the same
thing, only with this difference, that the former is the
product of a rich wine, and the latter of a poor one; or,
at the utmost, they differ only as our two home products,
the cyer-spirit and the crab-spirit, do.

The wine-spirit, distilled in England, is not easy to be
had pure and unmixed at our distillers, nor under a price
almost equal to that of French brandy; so that if it
never be required out of the trade, it is as well to use the
French brandy, which will, in all cases, serve the same
purposes, unless where a high flavour or a copious
essential oil are required. All other spirits are carefully
diluted of their oil in the rectifications; but the wine-
spirit is coveted only for its oil, and all that can be
obtained is preferred in this, its principal use being to give
a flavour to a worse spirit, and to cover the taste of a dif-
agreeable oil in it.

When a cask of wine chances to turn four in private
hands, it is worth while to distil it for the spirit. The
lees, also, if in any considerable quantity, will yield such
a proportion of the same sort of spirit, as to render it
worth while; and as the high flavour is not required in
this intent, it will be best to draw the spirit very
gently, either by the cold or hot stills, and afterwards it
may be rectified without any addition, and reduced to the
standard-strength of proof. It thus makes a very
clean and pleasant spirit, though very different from the
brandy from the same country the wine came.

Shaw's Essay on Distillation. See SPIRIT.

WINE, Philosopbic Spirit of the writings of some che-
menists and physicians a phrase that often occurs as the
name of a liquid prepared from wine, and ended with
very remarkable properties.

It is generally supposed that this was the same sort of
liquor, which at this time call by the name of spirit of
wine; but this is a very erroneous opinion, and has led
many into errors, about the operations in which it was
concerned. It was truly no distilled liquor, but the spirit-
rurious parts of wine condensed and concentrated by the
freezing of the more aqueous parts.

WINE VINERAR, Method of making of. See VINEAR.

WINE, Laws relating to.

Wine may be imported only in British-built ships, or
vessels of the built of that country which the wine is the
produce, legally navigated; or in ships the built of the
country in Europe under the dominion of the sovereign
or state in Europe, of which the wine is the produce, or of
the usual place of shipping. Penalty, forfeit of the
wine and the ship. 12 Car. II. c. 18, and 27 Geo. III.

No other than Rhenish wine may be imported from
the Netherlands or Germany, on forfeiture of ship and goods.
13 & 14 Car. II. c. 11. But wine, the produce of
Hamburg, may come from Hambro'; also wine, the produce of
Hungary, the Austrian dominions, or any part of
Germany, may come from the Austrian Netherlands, or any
place subject to the emperor of Germany or house of
Austria. 1 Ann. Stat. 1. c. 12, and 25 Geo. III. c. 78.

Wine may not be imported in vessels under fifty tons bur-
then; and veffel forfeited. 24 Geo. III. c. 47.
26 Geo. III. c. 59. and 45 Geo. III. c. 121. Spanish
and Portugal wines may not be imported in any casks con-
taining less than a hogshead, except for private use.
18 Geo. III. c. 27. and 25 Geo. III. c. 69. French
wine the same; and, except French wine in bottles, from
France, Guernsey, Jersey, or Alderney. 18 Geo. III.
c. 27. and 17 Geo. III. c. 13. By the 5 Ann. c. 27. a
hogshead is to contain 63 gallons, or 231 cubical inches
of wine. (i.e. not Spanish nor Portugal) may not be
imported in flasks, bottles, or casks, containing less than
25 gallons, except of the produce of the dominions of the
great duke of Tuscany, in open flasks, or any part of the
Levant, and also wine for private use. 1 Geo. II. fl. 2,
c. 17. and 25 Geo. III. c. 69. Wine may be imported in
cases containing fix dozen reputed quart bottles at the
least. 39 & 40 Geo. III. c. 83. 42 Geo. III. c. 44,
and 45 Geo. III. c. 121. Five reputed quart bottles
drew a gallon in charging duty. Wine not to be im-
ported unless accompanied by a manifest, attested by the
custos at the place of shipment. 26 Geo. III. c. 40.
Wine must be entered at the custom-house and excise-office
within 20 days after the ship has reported, or it may be
sold for the duties, and must be removed from the quays in
10 days. 26 Geo. III. c. 59. and 35 Geo. III. c. 118.

Wine landed without payment of duty is forfeited
(20 Geo. III. c. 59.); but wine may be warehoused under
schedule B; without payment at the time of entry of the
duties due on importation, on the importer giving bond to
export the same, or pay the duties within 12 months. But
duty must be paid when taken out, on any excess or defi-
cency, from the quantity taken at the time of landing; and
no wine to be warehoused in casks less than 45 gallons.
43 Geo. III. c. 132. Wine that has been warehoused
may be exported, and wine that has paid duty may be
shipped for drawback; but must be packed in the pre-
cence of the proper excise-officers, and the casks to be
sealed with their official seals; and if they are afterwards
damaged or broken, the party offending to forfeit 50l. for
each cask or package. Due notice to be given in writing
of the times of packing and shipping. 26 Geo. III. c. 59.
f. 46. 47. The exporter to give bond before shipping
that the same shall be exported to the place entered for,
and shall not be relanded or unshipped. To be landed in Great
Britain, on forfeiture. 26 Geo. III. c. 59. f. 48.
35 Geo. III. c. 118. Wine may be exported to Douglas, in the Isle of Man, in British vessels of 50 tons, by licence of the commissioners of the customs. 52 Geo. III. c. 140.

All the duties paid upon wine shipped for the actual consumption of officers of the navy on board ship, to be drawn back according to the following proportions.

33 Geo. III. c. 48.

Officers of marines to be allowed half a ton per annum.

53 Geo. III. c. 44. But to be shipped only at the ports of London, Rochefort, Dover, Dartmouth, Portsmouth, &c.

Dealers to remove their stock from one ship to another, and dispose of it to other officers. 38 Geo. III. c. 33.

Dealers in foreign wine to enter their premises at the excise-office, on penalty of 100l. for every place not entered, and forfeiture of the wine found therein. 26 Geo. III. c. 59. f. 12. Dealers to have the words 'Dealers in foreign Wines' painted on their doors, on penalty of 50l. fct. 15.

Retailers to have the word 'Wine' exhibited in some conspicuous part of their premises, on penalty of ten shillings. 30 Geo. II. c. 19, and 32 Geo. II. c. 19.

Dealers to take out a licence, to be renewed ten days before the expiration of every year, on penalty of 100l.; but not to apply to auctioneers selling wine by auction. 26 Geo. III. c. 59.

Retailers of foreign wines, and dealers in sweets or British wines, to take out licences also; and selling them after their expiration, and before renewed, subjects them to 60l. penalty. 30 Geo. III. c. 18. Retailers not to sell wine in their houses, unless they have a beer licence granted by the magistrates, on penalty of 20l. See Ale-House.

Officers may enter at any time to take an account of the stock, but if they go in the night they must be attended with a constable. The party refusing them admittance, or obstructing them, forfeits 100l. 26 Geo. III. c. 59. f. 17.

No wine to be brought into a dealer's posseffion without a permit, and dealers to mark on a conspicuous part the consent of each cask. 26 Geo. III. c. 59. f. 32. Any excess in a dealer's stock from the account last taken, after deducting the quantity sold and entered in their books, deemed not to have paid duty, and is forfeited, and double the value. 26 Geo. III. c. 59. f. 59. 27 Geo. III. c. 31.

Different kinds of wine and liquors, (cyder, spirits, &c.) to be kept separate. 26 Geo. III. c. 59. 42 Geo. III. c. 93. And no dealer in foreign wine to have any sweets or British wines in his posseffion. Penalty 100l. per gallon. 26 Geo. III. c. 59. f. 9.

Account of wine daily to be kept, and no quantity above three gallons to be removed without permission, in forfeiture of the fame, and the carriage and horse. 26 Geo. III. c. 59. 42 Geo. III. c. 95.

Wine, in possession of persons not dealers, may have permits granted for its removal, on proving to the satisfaction of the commissioners of excise, or the collector or supervisor of the district, that the duties have been paid. 26 Geo. III. c. 59. f. 33. Permits not used to be returned to the officer, on penalty of treble the value of the wine. 26 Geo. III. c. 59. f. 37, 38; and persons forging or counterfeiting them to forfeit 200l. Ibid. fct. 39.

For the laws relating to low wines and domestic wines, see Distiller, and Sweets.

WINE of Squills. See Squills.

WINE-Measure. See Measure, and Laws relating to Wine Paper.

WINE-Fly, in Natural History, the name of a small black fly, found in empty wine-casks, and about wine-lees, and called by the Latin, Bibio. It is produced of a small red worm, very common in the sediment of wine.

The drippings of wine or beer vessels, the pressings of the wine or cyder press, the pots in which honey has been kept, and in which a little remains sticking to the fides, and turning four, all afford vast numbers of a small species of worm or maggot. This is of a white colour, and has two books placed near the head; in short, it resembles in all the parts the maggot of the common flesh-fly. Multitudes of these small creatures live and move very briskly about in these substanccs for several weeks together; but at the end of that time, when they have arrived at their full growth, they enter into the nymphen-flate under a covering or cape made of their own skin, which dries, and becomes of a brown colour. After eight or ten days in this flate, the cape is opened by the falling off of a small piece at the end, and the fly makes its way out. The fly is extremely small when its wings are not extended.

It does not exceed the size of the head of a middling pin; it is however very beautiful; the breast and body are yellow, the reticulated eyes are red, and the wings have all the rainbow-colours. The best way of procuring these little flies, which make a very beautiful microscope object, is to keep the matter, in which the worms are placed, in a glads, covered down with a paper; as soon as the cover is taken off, at the time of their being in the fly-flate, they rise up at once in the form of a cloud; enough of them for observation will however remain about the sides of the vesell. When examined, they are found to have all the regular parts of the larger flies; their antennae are oval and flattened, and their legs, and every other part, are as elegantly perfect, as they are seen to be in the most elegant large fly.

It is not known whether they are oviparous or viviparous; but this is to be observed, that they give us great light into the origin of animalculc in different fluids.

Since we fee in these the evident course of nature in their origin, what prevents but that there may be numbers of flies yet smaller than these, whose eggs may be deposited in the fluids in which we find our microscope animalcules. Reaum. Hist. Inf. vol. ix. p. 82.

WINEBAGO, in Geography, a lake of North America. N. lat. 43° 50'. W. long. 87° 40'.

WINEBOGO River, a river of America, which runs from WINEBago lake to Green bay into lake Michigan. The WINEBago Indians inhabit near this river and lake, in about N. lat. 43° to 44°. W. long. 84° to 85°.

WINEBAGOE CASTLE, an Indian settlement in North America, near WINEBago lake.

WINE or Black River, a river of South Carolina. See BLACK RIVER.

WINERSTA, a town of Sweden, in East Gothland; 18 miles N.W. of Linkoping.

WING, in Botany and Vegetable Physiology, is generally used for any appendage to a seed, which serves to assist in its flight through the air. In this sense, the feathery crown of the Dandelion, and other fyngeenous plants; the membranous expansion at the top of the fuscious seeds, so curiously and variously constructed in different species; the long feathery awn of the Sinpa; and the delicate silky plumage
plumage of many birds among the order of Contortes, are 
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genera of birds, pref. p. 4.
Wings, Warbling of. See Warbling.

Wings, in Heraldry, are borne sometimes single, sometimes in pairs, in which case they are called conjointed; when the points are downward, they are said to be inverted; when up, elevated.

Wings, in Gardening, &c. denote such branches of trees, or other plants, as grow up afide of each other.

Quintiness says, the term is particularly applied to artichokes, whose wings, or ale, are the leffer heads, or fruits, that grow up with the principal one on the same falk.

Wings, Ale, in the Military Art, are the two flanks, or extremes of an army, ranged in fform of battle; being the right and left fides thereof, and including the main body.

The cavalry are always posted in the wings, i.e. on the flanks, on the right and left fides of each line; to cover the foot in the middle.

Pan, one of Bacchus's captains, is said to have been the first inventor of this method of ranging an army; whence, fay they, it is, that the ancients painted him with horns on his head; what we call wings, being by them called cornua, horns. This at leaft is certain, that the method of arranging in wings is very ancient. The Romans, we know, used the term ale, or wings, for two bodies of men in their army; one on the right, the other on the left, conflilling each of four hundred horses, and four thoufand two hundred foot ufually, and wholly made up of confederate troops. These were designed to cover the Roman army, as the wings of a bird cover its body.

The troops in these wings they called alares, and alares copie; and we, at this day, diftinguish our armies into the main body, the right and left wings.

Wings are also used for two files, that terminate each battalion, or squadron, on the right and left. The pikes used to be ranged in the middle, and the musqueteers in the wings.

Wings, in Fortification, denote the longer fides of horn-works, crown-works, tenailles, and the like outworks, including the ramparts and parapets, with which they are bounded on the right and left, from the gorge to their front.

These wings, or fides, are capable of being flanked, either with the body of the place, if they stand not too far diftant, or with certain redoubts; or with a traverfe made in the ditch.

Wings, in a Ship, the places next the fide upon the orlop, ufually parted off in fhips of war, that the carpenter and his crew may have free access round the fhip in time of action, to plug up flaw-holes, &c.

Wings are also the flits or extremities of a fleet, when it is ranged into a line a-breadth, or when bearing away upon two fides of an angle.

It is ufual also to extend the wings of a fleet in the day-time, in order to difcover any enemy which may fall into their track. To prevent Separation, however, they are commonly fummoned to draw nearer to the centre of the squadron before night, by a signal from the commander-in-chief, which is afterwards repeated by ships in the intervals. Falconer.

Wing-Transform, the uppermost transform in the flate-frame of a ship, &c., upon which the peels of the counter-timbers are relift. It is by fome called the main-transform.
WINGS, Goose. See Goose.

WING, St. Michael's, is the name of a military order in Portugal, instituted, according to the Jefuit Mendoza, in 1165; or, according to di Michieli, in his Teforo Militar de Cavalleria, in 1171. Its insitutor was Alphonfus Henry I. king of Portugal; and the occasion was a victory gained by him over the king of Savil, and his Saracens; for which he thought himself beholding to St. Michael, whom he had chosen for his patron in the war against the infidels.

The banner they bore was a wing resembling that of the archangel, of a purple colour, encompassed with rays of gold. Their rule was that of St. Benedict; the vow they made was to defend the Chriflian religion, and the borders of the kingdom, and to protect orphans. Their motto, Quis ut Deus!

Wing-Walls, of a bridge or lock, are playing-walls for diminishing the width of the canal to such bridge or lock, and for keeping up the banks.

WINGE, in Geography, a river of France, which runs into the Demer, 2 miles W. of Arlhot.

WINGED, in Botany, a term applied to such items of plants as are furnished, all their length, with a sort of membranous appendage.

Several kinds of thistles have winged stalks and branches. WINGED Leaves are such as confift of dillee little leaves, ranged in the fame direction, on each side of a rib or talik, so as to appear no more than one and the same leaf. Such are the leaves of agrimony, acacia, aff, &c. See WING.

WINGED Seeds are such as have down or hairs on them, by which the wind taking hold blows them to a distance.

WINGED stalk. See Stalk.

WINGED, in Heraldry, is applied to a bird when its wings are of a different colour, or metal, from the body. Winged is also applied to any thing represented with wings, though contrary to its nature; as winged or flying hart, &c.

WINGER, in Geography, a town of Norway, in the province of Aggerhuus; 2 miles S. of Kongwinger.

WINGHAM, a village and parish in the hundred of its own name, and lathe of St. Augustine, in the county of Kent, England, is situated 34 miles E. from Maidstone, and 62 E. by S. from London. A college of a provost and six secular canons was projected here by Kilwardby, archbishop of Canterbury, but settled and endowed by his successor, Peckham, in 1286. It was valued at 8l. per annum at the general suppression. By Edward VI. the college, with the patronage of the church and all tythes, were granted to Sir Henry Palmer. The building, now called the college, and which formed the manfion of the Palmers, appears to have been the provost's lodge. The church contains memorials of the Palmers and the Oxendens, who have a seat at Deane, in the parish. A double row of stalls still exists in the chancel. Wingham gives a title to earl Cowper, who, however, has no estate in the parish. It gave birth to Henry de Wingham, chancellor of England, bishop of Winchester, and afterwards of London. In 1511 the inhabitants of the parish were 859, who occupied 162 houses.


WINGHAM's island, a small island in the North Pacific ocean, near the W. coast of North America; 3 miles N.W. of Kaye's island. N. lat. 60° 4'. E. long. 215° 46'.

WINGROD, a town of Austrian Poland, in Galicia; 16 miles N.W. of Sniatyn.

WINHALL, a township of Vermont, in the county of Bennington, with 429 inhabitants; 30 miles N.E. of Bennington.

WININGEN, a town of France, in the department of the Rhine and Mofelle, on the N. side of the Mofelle; 5 miles W. of Coblenz.

WINKEL, a town of France, in the department of Mont Tonnerre; 14 miles W. of Mentz.

WINKELMAN, Abi John, in Biography, a German antiquary, was born at Standal, in the Mark of Brandenburg, in 1718. Although born in very humble life, he fortunately enjoyed favourable opportunities of cultivating his talents in that department in which he afterwards attained to eminence. He had arrived at the age of 37 years before he was known to the public as an author. His first work was "Reflections on the Imitation of the Greeks in Painting and Sculpture;" and it was received in a manner that very much contributed to establish his reputation. At the court of Augustus, king of Poland, he was profelyted to the Catholic faith, more, as some have said, by arguments addressed to his worldly interest, than to his spiritual welfare. It is certain, however, that he much wished to visit Italy for the sake of examining those masterpieces of art that were to be found in that country. With this view he left Dresden, and in passing through Florence in 1756, he made a descriptive catalogue of the antiquities in the collection of the celebrated baron de Stofch, which seemed to introduce him with advantage to Rome, whither he proceeded towards the close of this year. His acquaintance with the famous painter Mengs, Bianconi, and several other ingenious artists, forwarded his accefa to two of the most celebrated literary men at Rome, cardinal Paffionei and the prelate Giaconelli; from whose library and learning he derived much useful information, so that he was soon acknowledged as a man of fine taste, and a distingifhing connoifeur in works of art. Assuming the ecclesiastical habit, he succeeded the abbe Venuti as keeper of the pope's cabinet of antiquities; and he was also appointed copyist in the library of the Vatican. Under the patronage of the pope, who increased his income out of his privy-purfe, he completed his History of Art among the Ancients, and then left Rome in 1768 to visit his friends in Germany, and to revile his work to be tranflated into French by M. Troufant of Berlin. On his return to Rome by way of Triefte, he was affilliated, in June 1768, by a wretch who had joined him on the road, and who had fo far gained his confidence, that he had thrown him some gold medals and valuable presents which he had received at Vienna. "Abbe Winkelmann," says one of his biographers, "was of the middle size, with a very low forehead, a sharp nose, and black hollow eyes, which gave him rather a gloomy appearance. An ardent and impetuous disposition often hurried him into extremes. Naturally enthusiastic, he frequently indulged an extravagant imagination; but as he polifhed a strong and folid judgment, he knew how to give things their jult value. In confequence of this turn of mind, as well as a neglected education, he was a stranger to cautious revere. If he was bold in his decisions as an author, he was flill more fo in his conversation, and often made his friends tremble for his temerity." The tranflation of his History of the Arts was completed only in part by Troufant. Another French tranflation was published by Huber, professor at Leipzig. It is faid that the left French tranflation is far preferable to the first, as it was made from an enlarged edition of the original, printed at Vienna in 1776, after a MS. left by the author. Among the other works of Winkelmann were, "Letters on the Discoveries made at Herculanenum," tranflated into English by Mr. Gough; "Unpublished Monuments of Antiquity, such as Statues, ancient Paintings, engraved Stones, Bar-Reliefs, in Marble and,
WIN


WINKOP's Bay, or Wine Cooper's Bay, in Geography, a large bay on the south coast of Java. S. lat. 7° 7'. E. long. 106° 58'.

WINKOP's Island, a small island near the south coast of Java. S. lat. 7° 28'. E. long. 106° 36'.

WINKOP's Point, a cape on the south coast of Java. S. lat. 7° 25'. E. long. 106° 36'.

WINLATOM, a township of Durham; 6 miles W. of Newcastle.

WINNEBAGO. See Winebago.

WINNENBURG, a citadel of France, in the department of the Sarre, which heretofore gave name to a lordship within the archbishopric of Treves; 1 mile N.W. of Cochem.

WINNENDEN, a town of Wurttemberg. In the year 1693, this town was laid in ashes by the French; 12 miles E.N.E. of Stuttgart. N. lat. 48° 53'. E. long. 9° 30'.

WINNICZA, a town of Poland, in the palatinat of Braclaw; 32 miles N.N.W. of Braclaw.

WINNING of Hay, in Agriculture, a term sometimes applied to the operation of making hay in certain climates of the weather. See Hay-Making.

WINNINGE, in Geography, a river of Lancashire, which runs into the Lune, 6 miles N.E. of Lancaster.

WINNINGEN, a town of Westphalia, in the principality of Halberstadt; 4 miles N. of Anfehrleben.

WINNIPEG, or WINIFIC, a lake of Upper Louisiana, being the great reservoir of several large rivers, and supposed to be the largest of the inland seas, near the heads of the Mississipi, which discharges itself by the river Nelson into Hudson's bay. It is connected with other lakes to the N.W., and has, from the rivers entering into it, an inconsiderable portage to the waters of lake Superior. This lake is said to be 240 miles in length, and from 50 to 100 in breadth, though in some places it is hardly five. N. lat. 52° 10'. W. long. 97° 30'.

WINNIE or WINPIEG RIVER, a large body of water, interspersed with numerous islands, causing various channels, and interruptions of portages and rapids. The lake Du Bois discharges itself at both ends of an island, on which is the carrying-place out of the lake, and which is named Portage du Rat, in N. lat. 49° 37', and W. long. 94° 25', about 50 paces long, and forms this river. In some parts, the river has the appearance of lakes, with ready currents; its winding course to the Dalles is estimated at 8 miles; to the Great Decharge 253 miles, which is a long carrying-place for the goods; from thence to the Little Decharge 13 miles; to the Tunajouge Portage 24 miles; then to its galet or rocky portage, 70 yards; 25 miles to the Tun Blanc, near which is a fall of from four to five feet; 33 miles to Portage de piff, where is a trading port, and about 11 miles on the N. shore a trading establishment, which is the road, in boats, to Albany river, and from thence to Hudson's bay. There is also a communication with Lake Superior, through what is called the Nipigoes country, that enters the lake Winipeg above 55 leagues E. of the Grande Portage. Mackenzie's Voyages, &c. Introd. p. 60.

WINNIE, Little, a lake of North America, 80 miles long and 15 wide. N. lat. 52° 10'. W. long. 100° 15'.

WINNIPISOGEE, or WINNEPIKKEE, a lake of New Hampshire; 80 miles N. of Boston. N. lat. 43° 35'. W. long. 71° 18'.

WINNOW, in Agriculture, signifies to fan, or separate corn from the chaff by wind.


WINNSBOROUGH, in Geography, a town of South Carolina; 30 miles N. of Columbia. N. lat. 34° 28'. W. long. 81° 15'.

WINNY HAY, in Agriculture, a term applied to hay in some conditions of it. See Hay.

WINSCHE, or WINSCHEOTTEN, in Geography, a town of Holland, in the department of Groningen, near which the Spaniards were defeated by Louis, brother to the prince of Orange, on the 24th of May 1568. The Spaniards lost 2500 men, all their baggage, and six pieces of cannon. This was the first battle fought on account of the Revolution, and gave the prince a happy preface of success; 19 miles E. of Groningen.

WINSDER, a river of Norfolk, which runs into the Yare, 12 miles W.N.W. of Norwich.

WINSEN AER DER ALLER, a town of Westphalia, in the principality of Luneburg, on the Aller; 6 miles below Zell.

WINSER AER DER LUBE, a town of Westphalia, in the principality of Luneburg, on an island in the lake; 12 miles S.E. of Hamburg.

WINSWO, JAMES BENIGNUS, in Biography, an eminent anatomist, was born in 1669 at Odensee, in the isle of Funen, and having studied a year under Borrichius, was sent with a pension from the king of Denmark to seek improvement in the principal universities of Europe. In 1698 he became a pupil of the celebrated anatomist Duverney at Paris, and during his residence in this capital, he abjured Protestantism, and was confirmed by Boeuffet, assuming in addition to his own baptismal name that of his convert, Benignus. Haller denominates Winslow "simple and superstitious," and of course his conversion to the Catholic faith afforded no great occasion for triumph. This event, however, detached him from his family and native country, and was the means of fixing his abode in France, where the patronage of Boeuffet was highly favourable to his advancement, and served to obtain for him the degree of doctor in 1705. In 1707 Duverney recommended him to be an eleve of anatomy in the Academy of Sciences. He afterwards read lectures of anatomy and surgery for Duverney at the royal garden; and in 1743 was promoted to the professorship in this institution. In the meanwhile, he communicated several papers on anatomical and physiological subjects to the Academy of Sciences, by which body, as well as by the Royal Society of Berlin, he was admitted into the number of associates. His great work, mentioned by Haller as supereding all former compositions of anatomy, and entitled "Exposition Anatomique de la Structure du Corps Humain," first appeared at Paris in 1732, 4to. It was frequently reprinted, and translated into various languages; and is still regarded as of standard authority. Winslow planned, but never finished, a larger work, of which this was merely an abridgment, and he was also the author of disputations and treatises on particular topics. He died in 1760 at the advanced age of 91. Haller. Eloy. Gen. Biog.

WINSWO, in Geography, a market-town in the county of Buckingham, England, 63 miles from Buckingham, and 51 N.W. from London. The market, now inconsiderable, was granted in 1235 to the abbot of St. Alban's, lord of the manor,
manor, by king Offa. The manor is now the property of
William Selby, esq., who has a seat in the town. The
parish-church, a spacious structure consisting of a nave,
two aisles, a chancel, and a tower, contains no monuments
of note. According to the population return of 1811, the
houses in the parish were 223, and the inhabitants 1222.
Here is a small market on Thursdays, and five annual
fairs.—Magna Britannia, by the Rev. D. Lysons and S.
Lysons, esq. 4to. 1806.

WINSLOW, a town of the province of Maine, on the
Kennebeck, in the county of the same name, containing 658
inhabitants; 88 miles N. N.E. of Portland.

WINSTER, a small market-town in the hundred of
High Peak, and county of Derby, England, is situated 5 miles
W. by N. from Matlock, and 152 miles N. W. from
London. The manor belonged to Henry de Ferrars when
the Domeday-survey was taken. At a later period it was
held by the Mountjews, who were succeeded by the Mey-
neills. The latter sold it to the freeholders in the reign of
queen Elizabeth. The town affords nothing worthy of
particular notice. It has a chapel of ease to the parish of
Youldrove, of which Whinler forms a part; and also a
chapel for the Wesleyan Methodists. A market is held on
Saturdays, which appears to be by preemption; for there
is no grant of it on record: till lately here was an annual
fair, but it is now discontinued. The population return
of the year 1811 states Winster to contain 217 houses, and
852 inhabitants; the latter are chiefly employed in the mining
business, and in the inferior branches of the cotton trade.
On the commons, in the vicinity of the town, are several
cairns, or stone bars, and also two or three barrows of
earth: in one of the latter, which was opened in the year
1768, two glass vessels were discovered, about nine inches
in height, containing a pint of water, of a light green colour,
and very limpid. With these a silver collar or bracelet
was found, together with some small well-wrought ornaments,
several beads of glass and earth, and remains of braes claps
and hinges, with pieces of wood, that seemed to have been
brought to a box in which the ornaments had been deposited.
The antiquities induced Mr. King to suppose the barrow
to have been raved over some Briton of distinction, though
long after the Romans were in possession of the island.—
Beauties of England and Wales, vol. iii. Derbyshire; by
J. Britton and E. W. Brayley, 1803. Lysons' Magna

WINSTON, a river of the county of Lancaster, which
runs into the Ken, at its mouth.

WINTON, a town of Prussia, on the Curich Haff;
14 miles N. of Precol.

WINTERNAU, a town of the duchy of Stiria; 2 miles
S. of Marburg.

WINTER, — in Biography, a German opera com-
poser, of great abilities, who succeeded Bianchi at our
Lyric theatre in 1803; during which year he produced, in
1803-4, the music of the ballet of Achille and Deidamia,
and for Mrs. Billington's benefit.

WINTER, one of the four seasons or quarters of the
year.

Winter properly commences on the day when the sun's
distance from the zenith of the place is the greatest, and
ends on the day when its distance is at a mean between
the greatest and least.

Notwithstanding the coldness of this season, it is proved,
in astronomy, that the sun is really nearer to the earth in
winter than in summer. The reason of the decay of heat,
&c. see under Heat.

Under the equator, the winter, as well as the other se-

Vol. XXXVIII.
From the middle period of the above month, and through the following, they must also be defended from frost, in order to promote the coming bloom. Great care and attention are especially necessary for blooming the plants well from the above time in March to near the end of the succeeding month, as in this time they will most likely attain their greatest perfection and beauty. It is only necessary, as it is thought, for blooming such flower-plants in the greatest perfection, to have them continuously under glass, night and day, for about twenty-four of the last days, as they will then have their middle pips well expanded. In very strong sun they must be slightly shaded by a thin mat, but in other cafes they may be thrown open and exposed to the full free air.

After the beginning of April, as the fifth or sixth, the glasses of the frames are to be kept completely over the plants night and day, until they are in full bloom, only letting in proper supplies of air from behind the frames, and giving the shade of old thin mats when necessary. This mode is to be pursued to about the middle of this month; but the plants are not to be over-halted in their bloom by too much sun, as that may fade their fine colours; but in such cafes they must be removed from the full southern exposure to a full eastern one, though by no means yet to a northern aspect, as that would endanger their bloom; if the season be suitable, the protection of a privet-hedge, wall, or paling-fence, is the most proper, being covered by hand-glases; when about the end of the month, they may be removed to a northern exposure on flaggs, or in other proper places.

In this finishing blooming eastern exposure, all the mats and other coverings should be taken off from the glusses that are placed over the flowers, about seven o'clock in the morning, and in sunny weather the plants be shaded from about nine to twelve or one, the thin mats being then removed. The covering-glases are to be prepared by well washing, and other means.

The flowers in blooming are mostly much benefited by having a south-well exposure as much as possible, and by carefully attending to the north and north-east winds, as well as by receiving all mild moderate rains from about the beginning of February until towards the end of March. In the latter part of this time, before the trifles are too forward, and the blossoms open, three or four hours rather heavy mild rain greatly promotes the swelling of the pips, and much increases the size of the foliage, especially if care be taken immediately after it is over to flout the flowers close down, and cover them up in a warm manner, as below. Watering them from a pot with a fine rose in a warm sunny day all over the leaves in the afternoon, in the manner of rain, and directly covering them up warmly while the sun is upon them, has likewise been found beneficial. They are now, too, to be well guarded from late frosts, as they are so soon destroyed by them.

In the late winter, or early spring, night-covering, as from the middle of the above month, the following mode has been found highly beneficial, in not only repelling the cold frothy night-air, but in affilling the bloom, and preventing its being checked in any way thereby.

The heat at this period being usually from about forty-five to fifty degrees in the day-time, the flowers may be exposed to the open air in it, and in covering them in the night, be kept near to that state; which is only to be effected by an artificial covering of some fort or other, for other forts of heat do not answer the purpose; as those of the warm blanket, horse-cloth, thick-flax, and other similar kinds, laid next to the glusses, over which mats may be placed so as fully to protect the flowers, and keep the other coverings from being injured by rain or other wetness. Where wood-frames and not brick ones are used, it is also often necessary to have hay, fern, straw, or some other such material, applied on the outsides of them, to guard against the penetration of the cold frothy air, as is otherwise liable to be the case in severe scenes. But such full coverings should not be had recourse to in the winter season sooner than the middle of March, as they might not only injure the fine strong blooming plants, but counteract the good effect they are intended to have in affilling nature to gradually bloom the flowers in fine condition as the season approaches. The keeping the flowers so warm on the nights at this period of the season is supposed to prevent any check to the vegetation of the plants; and another great effect which it has, is that as soon as the pips open, they proceed vigorously, expand freely, and come out level, fine, and nearly flat; while, if they once get a complete chill by cold night air, their blossoms will not expand flat, but on the contrary, ruffle or tumbled.

In the leaves of the auricula and some other kinds of plants, there is as much variety produced by these means in the shades of their green as in the colours of their flowers. The green of the leaves, or green, as it is termed, in this sort of flower-plants, should conically be that which affords the best contrast, and has the most power in setting off the flower to which it belongs. Different varieties in the shade of the leaves also proceed from the nature of the culture and management, as well as from the raling them from feed. They have from these caules leaves with smooth even edges, with thick and flaky edges, and with thin edges. These varieties in the leaves of such plants are often of importance to the florist in different ways. In the grases or green leaves of these plants, there is likewise some variety in the mealy dull or farina which is upon them; in some the whole plant is nearly covered with it; but these with blue-flax or green leaves are commonly the most powdered with this fort of dull, which contributes not only to the beauty of the plants, but serves in some degree to prevent them from the effects of the scorching heat of the sun during the summer season.

The different other fine flower-plants are to have something of the same sort of winter-management pursued for them, only making proper allowances and distinctions, in so far as their differences in the nature of their growths or other habits are concerned.

The diversities of the auricula, as well as most other flower-plants, owe their present perfection, in a great measure, to the care, ingenuity, cultivation, and management of the florist-gardener, and some of these private individuals who cultivate flowers for the amuement and delight which they afford. By these means, this and many other sorts have been wonderfully improved, which were at first single and simple; and their variety, size, and beauty, have been increased in an astonihing manner. The sportsiveness of nature has likewise been much, as is evident in so many flower-plants; as in the daisy, ranunculus, the anemone, the fock, the wall-flower, the pink, the carnation, the Siberian larkspur, and a valt many more.

There is, indeed, something extraordinary in the great and uncommon divery of the colours, and the differences of the shades and hues of this as well as some other flowers; and it is not left singular or true that out of more than an hundred flowers of this sort, which are raised from seed in this way, there will not, perhaps, be two which are exactly alike; and that yet, in all these deviations, the changes take place in the most naturally pleasing, agreeable, and unthought-of manner possible.

By
WIN

By attention to proper winter and other management, till
more diversity and variety may most probably be produced
in this and different other flowers.

Winter, among Printers, that part of the printing-
pref, serving to sustain the carriages &c. See Printing-
Pref.

Winter's-Bark, Cortex Winteri, or Winteranus,
Wintera Aromatica; which see. See Cortex

This is one of the largest forest-trees upon Terra del
Fuego, often rising to the height of fifty feet. Dr. Solomon
has given an accurate botanical description of it, illus-
trated by a figure, in Med. Obs. and Inq. vol. v. p. 46,
&c. Its leaves are ever-green, smooth, oval, and entire; its
flowers consist of seven petals, from fifteen to thirty
filaments, and from three to five seeds, terminating in
as many stigmas; each germ becomes a feed-veffel,
containing several seeds: the bark of the trunk of the tree
is externally grey, and very little wrinkled. The pieces of
this bark brought over by the Dolphin are about three or
four inches square, of different degrees of thickness, from
one-fourth to three-fourths of an inch. It is of a dark
brown cinnamon colour, an aromatic smell if rubbed, and
of a hot, pungent, spicy taste, which is lailing on the palate,
though imparted flightly. A watery infusion of it, turk a
black colour with a solution of green vitriol. An infusion
of two ounces, coarsely powdered, yielded on evaporation
two drachms and twenty-four grains of extract: the fame
quantity, with rectified spirit, afforded two drachms of
extract.

This bark, though much celebrated as an antiscorbutic
by the first discoverers, is unknown in the practice of phy-
sic; the canella alba, (see Cannela,) which is totally dif-
ferent from it, having been confounded with it in the shops;
and no quantity having been brought to Europe, except as a
curiosity, till the return of the ships lent out on an expedi-
tion to the South seas. It has been thought to be a useful
antiscorbutic; but it seems to pollute in this respect no ad-
antage over the other pungent aromatics, and it is now
generally superceded by the canella alba.

From some experiments on this bark by Dr. Morris, it
appears to be an astringent of a particular kind, and there-
fore likely to be of use in several manufactures; and that
water is the proper disolving of it.

It is hoped that this tree, no less useful than elegant,
may be cultivated in our country, where it would probably
grow luxuriantly, as in a much warmer region than its own,
and furnish, not only a valuable ever-green, bearing our fe-
verlest winters, but also a valuable medicine. Med. Observ.
ubisupra.

Winter-Barley, in Agriculture, a term applied to an ex-
cellent fort, which is put into the ground in the autumn,
and which flands the winter. It is found by some farmers
to be very productive in its nature, and when made into
malt to form a much stronger fort than that which is pro-
duced from common barley.

In some districts, it is a good deal sown and cultivated as
an early sheep-feed, in which intention it often answers very
well. See Barley.

Winter-Berry. See Prinos.

Winter-Bloom. See Azalea.

Winter-Cherry. See Physalis Alkekengi.

Winter-Creffs. See Erysimum Barbarea.

Winter-Crops, in Agriculture, a term used to signify all
such as are put into the soil to grow or rife at that time of
the year, which are capable of withstanding that severe sea-
fon, or which can be converted to the purpose of fodder for
animals at that inclement and neccllous period.

Winter-Fallow. See Fallow.

Winter-Garden, a term often applied to that kind of
ornamental garden which is chiefly for use and amuement
at that season of the year. It has been advised by Mr.
Loudon, that a winter-garden should contain all such trees,
brubs, plants, and other vegetable productions, as are in a
state of perfection, or retaining their beauty and verdure, at
and during this season, in the most complete manner; as
most of the ever-green tribe or class of trees and shrubs,
many flowering plants, as the acorn, snow-drop, Chrift-
mas-rose, and several others of similar kinds; that these
should be grouped and arranged in the natural manner in
such garden-grounds; and that a dry gravel or other similar
kind of walk should be conducted throughout, or carried
round about the whole, in the view of being walked upon at
this season without inconvenience; that these forts of
gardens should be situated near the mansion or residence,
in order that they may be comfortably and conveniently ap-
proached in the different winter months; and that the con-
servatory too, as well as some other such houses, should be
placed in them.

Winter-Green, in Botany. See Pyrola.

The greater round-leaved winter-green, or pyrola rotundi-
folia major, is generally brought over from Switzerland
with other vulnerary plants, in which clafs it is ranged, and by
some greatly commended. Miller

Winter-Green, Ivy-flowering. See Kalmia.

Winter-Green, with Chickweed Flowers. See Trien-
talis.

Winter-Haying, in our Statutes, a season between the
eleventh day of November, and the three-and-twentyth
of April, which is excepted from the liberty of commoning
in the forset of Dean, &c. Stat. 20 Car. II. cap. 3.
Blount.

Winter-Pears, in Gardening, such as will keep, and are
ready for use in that season. It has been suggested in a
paper in the second volume of the "Memoirs of the Cale-
donian Horticultural Society," that in the cultivation of
pears of this fort, thofe of the pyrif-bearing sorts should be
carefully avoided; that they should be suited as much as
possible to the nature of the climate or region where they
are to be grown; that they should have their situation in
a proper exposiure, and in a proper foil; that they should
be well pruned, trained, and managed, in all other repreffes;
that thofe kinds which can be most depended on be had
recourfe to; that new varieties may probably be railed
from seed with advantage in this view; and that endeavours
should be made to bring into use any good late forts of this
fruit.

The number of winter-pears in the northern parts of this
island are supposed to be scanty indeed. That if the few
that have been favourably spoken of by fome cannot be
had, there are not, it is believed, above five more to be
depended on in thefe situations; which are thofe, the fwan-
egg, achans, brier-bufli, the John Monteth, and to which may
be added the muifowf-egg, which keeps there much longer
than the fwan-egg, and muft be allowed to be a winter-pear,
though commonly let down as an autumn fruit. The fwan-
egg has there, it is faid, never kept good longer than the
end of November, while the muifowf has fometimes re-
mained in good prefervation until towards the end of April.
In the then heat feafon they were taken from the tree, it is
faid, sooner than ufual; confentually were earlier ripe or
fit to eate, and of course have decayed more speedily, than
ordinary. They were, however, perfectly good until to-
wards the end of January in the following year, after which
they spoileil in a very fudden manner. The muifowf-egg
may
may also, however, with great safety, be allowed to remain
on the tree ten or twelve days longer than the swan-egg; the
leaves of the latter, too, fall, it is said, much sooner than
those of the former.

On walls, in different proper aspects, the following sorts
of winter-pears have, it is said, been recommended to be
planted: the creffane, the colmar, the boncretien d’hiver, the
chaumontelle, and some others, which are certainly excel-

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lent pears, but that some of them are fly-bearers, and
others do not ripen well in these parts, except in the most
favourable situations. Some have found the four following
sorts particularly useful on walls, especially in high situ-
ations in those northern parts of the country where the
other finer sorts do not ripen in a proper manner: the green
yair, mulirovell-eggs, swan-egg, and winter achen. But it is
noticed, that the second and the last of these sorts of
pears, when planted as standards, produce not only better
crops, but fruit of a higher flavour. Many other sorts are
mentioned by different writers as very good winter-pears
for the purpose of cultivation in these and other places; as
may be seen in the above useful paper.

Winter-Proud, in Agriculture, a term applied provin-
cially to such winter-wheat, or other crop, as puts on a
more green and luxuriant growth and appearance than it is
able to maintain and support in the following summer sea-
son; or in which the tillering shoots, branches, or rami-fi-
cations of the feed-grain, become too numerous to be nu-
rished and brought to maturity in consequence of the pre-
vious over-exertion of the soil or land. In these cases, the
crops decline during the spring and summer months, and at
the harvest time yield imperfectly, falling much below the
quantity afforded by such crops as had a more backward
appearance in the winter season.

It is of course always of advantage to have these sorts of
crops in rather a backward state in the winter period of the
year.

Winter-Quarters. See Quarters.

Winter-Rig, among Hudsonians, signifies to fallow or
tilt the land in winter.

Winter-Solstice. See Solstice.

WINTER, in Botany, is so called in memory of the
companions of Sir Francis Drake, Captain William Winter,
who brought the bark, of the first species, from the islets
of Magellan in 1579, and introduced it to the knowledge
of European physicians, as a valuable tonic, more espe-
cially useful in the scurvy. Linnaeus, meaning to commemorate
this discovery, established a genus by the name of Winteranora,
G. Pl. 238, the bark of which he conceived to be what
Captain Winter introduced. But the Linnaean plant is the
Canella alba, to the fructification of which alone the de-
scription applies. Browne had already founded this genus,
by the name of Canella, (see that article,) and Swartz, as
well as Murray, have confirmed it. Meanwhile Forster,
having found and investigated the fructification of the
Winter’s-bark tree, described it by the name of Drimys,
alluding to its hot and pungent flavour. This is retained
by the younger Linnaeus in his Supplementum, with a remark
properly distinguishing it from the Canella alba, though his
father, like prof. Bergius, Nat. Med. v. 1. 381, had con-

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founded them. Finally Murray, in Linn. Syll. Veg. ed. 14,
aware of these various errors and misconceptions, very pro-
curly establishes Browne’s genus, by its right denomination,
Canella, and restores Winter’s name to the plant to which it
properly belongs, and with which Linnaeus intended to asso-
ciate it. Murray, however, prefers Wintera to Winteranora,
which is the more judicious, as his genus is not really the
Winteranora of Linnaeus. The name he has chosen is now,
extexcept by an accidental mistake of De Candolle in chronol-
ogy, universally adopted. Perhaps Winteria would have
been better; but we refrain from embroiling the subject
with any further alteration, of what has received the func-
tion of such men as Murray and Schreber. — Murr. in Linn.

Gen. Ch. Cal. Perianth inferior, of one leaf, splitting
into two or three segments. Cor. Petals six, or more,
oveate, spreading. Stam. Filaments numerous, shorter
than the corolla, dilated upwards; anthers terminal, of two
lateral ovate cells, separate at the base, converging at
their points. Pist. Germenis four to eight, crowded, obovate;
styles none; stigmas defrrept, flat. Peric. Berries four to
eight, ovate, somewhat triangular. Seeds several, dispor-
ed in two rows.

Stamens club-shaped, with terminal two-lobed anthers.
Styles none. Berries superior, aggregate. Seeds several,
in a double row.

Obst. Willdenow copies what we suspect may be a
casual error of the younger Linnæus, germina clarvalis, for
flamina clarvalis. De Candolle, who describes two new
species, first gave a correct account of the arrangement of
the seeds, an important circumstance in this natural order.
His observations, confirming those of Linnæus, showed the
petals to be indeterminate in number. Possibly the line is
not drawn distinctly between them and the Flamina, of which
Nymphaea affords another instance, so that an inner series
of smaller petals may occasionally occur.

t. 7. Comm. Goett. v. 9. 34. 7. Soland. in Med. Obf.
(Drimys Winteri; Forst. Act. Upf. v. 3. 381. Linn.
Suppl. 269. Winteranorus cortex; Ch. Exot. 75. Dale
Pharmac. 324. Laurisæa magellanica, cortice acri;
Bauh. Pl. 461. “Periclymenum rectum, folis laurinus,
cortex aromatico acri; Solane in Phil. Trans. v. 17.
923. t. 1. f. 1.”)—Leaves elliptical, obtuse, coriaceous.
Flowers flanks aggregate, terminal. Pedils about four. —Native
of the country on both sides of the islets of Magellan, in
valleys exposed to the sun, where it was first observed by
Captain Winter, and has since been found by several follow-
ing navigators, but no one has brought living plants or
seeds to Europe. This is a tree of considerable size, often
50 feet high, with twisted knotty branches, and a thick rugged
bark, of an aromatic smell, and pungent permanent flavour.
This bark is not much used in practice at present, there being
many drugs of equal, or superior, powers; as the Canella alba,
which has taken its place, and caused the botanical mistake
above-mentioned. (See Winter’s Bark.) The leaves are al-
ternate, crowded about the ends of the branches, ever-green,
two or three inches long, and one a half wide, thick and
rigid, entire, somewhat revolute, with a flout midrib, and
scarcely visible veins, very smooth on both sides; somewhat
glaucescent, but not invariably or permanently so, beneath.
Flowers flanks broad and thick, smooth, half or three-quarters
of an inch long. Stipules none. Flowers flanks at the ends of
the branches, two or three together, simple or three-clft,
smooth, not half the length of the leaves, accompanied at

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their base by several ovate, pale, deciduous bracteas. Flowers

smaller
smaller than a hawthorn blossom, white. *Calyx* reddish, unequally three-lobed. *Berries* from three to five, each with four triangular *seeds*. By the above synonyms to this species it appears, that even G. Forster, who with his father established the genus and unexceptionable name of *Drimys* Long. gave way to those eminent botanists who wished to retain the memory of the original discoverer. Indeed the name of Winter may claim even a right of priority, though a mistake attended its commemoration and publication by Linnæus, in his *Gen. Pl.* We trust our amiable friend M. De Candolle will forgive our not joining with him, in overturning what has been finally settled, with the approbation of all the world. If chronology is to be our absolute guide, without attention to sense, or expediency, the nomenclature of botany must relapse into its primitive barbarism, and in this case Baudin's name *Laurifolia* should have been adopted. Even on this ground, weak as it is, we can however defend the name we have retained; for Clusius's *Winteranus cortus*, erroneously printed *Cortex Winteranus* by De Candolle, may be considered as the first commemoration of captain Winter, being the first publication of any thing relating to the genus in question.


Sent by Mutis from New Granada. It grows on the most lofty mountains of that country, Quito, &c. The tree is 18 or 20 feet high, with round branches, more straitly, and less rugged, than the foregoing. *Leaves* four or five inches long, and near one inch and a half broad, obtuse, not acute, scarcely revolute, perfectly smooth; very glaucous beneath, like those of *Magnolia glauca*, the longer-leaved variety of which they greatly resemble. *Flower-flasks* smooth, an inch long. *Flower-flasks* sometimes nearly the length of the leaf, always half as long, simple, divided, or three-cleft. *Flowers* twice the fivesize of *W. aromatica*, with about 12 petals, and a deeply three-cleft *calyx*. *Petals* six or eight, oblate, sometimes confluent, each with from four to six *seeds*. The *bark* is aromatic, like the former. The younger Linnæus imagined this to be a variety of that specie, caused by a warmer climate. They are indeed more nearly related than appears at first sight, and yet we can scarcely think they belong to one species, though well aware that the leaves, in this natural order, are liable to vary considerably in shape; witness the *Magnolia* just mentioned, if more than one species be not confounded under that name.

3. *W. chilenensis*. Chili Winter's-bark. (Drimys chilenensis; *De Cand.* n. 4.) *Leaves* oblong-obovate; glaucous beneath. *Flower-flasks* either aggregate or compound, axillary. *Petals* five or six.—Gathered by Dombey, in marshy situations in Chili. A tall *furb*, with a very aromatic bark, and round branches. *Leaves* nearly obvate, coriaceous, very smooth, tapering at the base, on short *flasks*, resembling the foliage of *Magnolia glauca*. *Flower-flasks* axillary; sometimes very short, bearing an umbel of four or five elongated simple *flasks*; sometimes four or five simple ones all together, each an inch long, at most, single-flowered. *Calyx* in two or three ovate blunt divisions, not foon decidiuous, and perhaps lasting till the fruit is ripe. *Petals* fix to nine, oblong, bluntish; twice the length of the *calyx*. *Stamens* very short. *Germens* five or fix, ovate, crowded, on a small globose receptacle. *Berries* oval, rather compressed, obtuse. *De Candolle.*


5. *W. xillaris*. Small-flowered Winter's-bark. *Forrt.* *Prod.* 42. *Wildl.* n. 3. *Mart.* n. 3. (Drimys xillaris; *Linn. Suppl.* 270. *Forrt.* *Act.* *Upl.* v. 3. 185. 186. *De Cand.* n. 1. *Lamarck* f. 2. *Linn.* n. 3. *De Cand.* n. 3. *Lamarck* f. 3. — *Leaves* obvate, pointed, reticulated with veins. *Flower-flasks* simple, aggregate, thread-shaped. *Calyx* oribicular, lobed, reflexed. — Native of woods in New Zealand. A tree, with round branches, rough to the touch, but not spiny. *Leaves* on *flanks* rather above half an inch long, broadly obvate, tapering to a bluntish point, smooth, more than half, and membranous than in any of the other species, coarsely reticulated with innumerable veins, not observable in any of those; their length three or four inches, breadth two; their under side glaucous when young only. *Flower-flasks* two or three together, feldom foliating, from the blemishes of most of the leaves, simple, very slender, each bearing a small green flower. *Calyx* dicotyled, four reflexed, about a line broad, splitting into two principal, and two smaller, lobes, not differing in any particular respect from the divisions of the calyx of the other species, thoughForster's figure has misled *De Candolle* to suppose otherwise. *Petals* six, oblong, flat, equal, four times the length of the *calyx*. *Stamens* about sixteen. *Germens* four, turbinate, all perfectly and evidently distinct, in the numerous flowers of the *Linnæan* specie; so that Forster might well wonder how the younger Linnæus, who had this very speciem before him, could make a "solitary pilum" a part of the specific character. *Stigmas* dilated, petalate, terminal. *Berries* four, globose, black, with a tawny pulp, lodging four *ovate*, acute, somewhat triangular, gibbous *seeds*. The flavour of the whole plant, especially of the bark, is extremely acrid and pungent. *G. Forster.*

WINERANA. See CANELLA, and WINTERA supr.

WINTERBERG, in Geography, a town of the duchy of Welfphalia; 37 miles S. of Paderborn. N. lat. 51° 11'. E. long. 8° 39'.

Winterberg, or Winberg, a town of Bohemia, in the circle of Prachatitz; 10 miles W. of Prachatitz. N. lat. 49° 2'. E. long. 13° 39'.

WINTERBURG, a town of France, in the department of the Rhine and Mofelle; 10 miles W.N.W. of Creutznach.

WINTERHAM, a place in Virginia, where black-lead is found: 30 miles N. of Richmond.

WINTERHAUSEN, a town of the duchy of Wurzburg, on the Main; 4 miles S. of Wurzburg.

WINTERINGHAM, a town of England, in the county of Lincoln; 166 miles N. of London.

WINTERTHUR, a town of Switzerland, in the canton of Zurich. This was formerly an imperial town. In the year 1467, it was mortgaged to the canton of Zurich, and by subsequent treaties entirely ceded, since which Winterthur
“Win” has acknowledged Zurich for its sovereign. It is governed, however, by a magistracy and police of its own. The government is aristocratical; the supreme power, in all things not interfering with the claims of Zurich, reposing in the Great and Little council, in all criminal proceedings these two tribunals unite, and pass sentence of death without appeal. In civil causes, an appeal lies from the Little to the Great council. In all cases respect for the burghers, appeals may be carried from the town-court to the council of magistracy, and no farther; but if either of the parties be a foreigner, an appeal lies from the council to the Senate of Zurich. A bailiff from this latter place likewise resides here, but without any authority over the town, excepting that of affixing at the ceremony of an annual homage paid to Zurich by the burghers on St. Alban's day. In case of a war, Winterthur furnishes Zurich with 200 men, either burghers or dependants, but to serve under its own arms. Except in the articles of silk manufacture, and the establishment of a printing-press for profit to Zurich, the commerce of Winterthur is under no restraint. The principal manufactures are, muslin, printed cottons, and cloth; it has some vitriol works; and the earthen-ware made here, particularly the white, together with its painted flores, are in great repute for their beauty and durability. The town is small, and the inhabitants, who are about 2000, are very industrious. The schools are well endowed and regulated. Ober Winterthur, or Upper Winterthur, is a small village near the town, on the high road leading to Frauenfeld, on the site of the ancient Vitodurum, which was a Roman station. Here are found the foundations of ancient walls and numerous Roman coins and medals. The castle of Kyburg, seated on an eminence overlooking Winterthur, is a picturesque object; 14 miles N.E. of Zurich.

WINTERTON, a town of England, in Lincolnshire; 9 miles N.N.W. of Granford. Also, a town of England, in the county of Norfolk, near the coast. The market is discontinued; 7 miles N. of Yarmouth.

WINTON, a town of Norfolk, on the coast of the county of Norfolk, on which is a light-house; 10 miles N. of Yarmouth. N. lat. 52° 44'. E. long. 1° 41'.

WINTFELDEN, a town of France, in the department of the Upper Rhine; 10 miles S.W. of Colmar.

WINTHYG, a town of Austria; 6 miles N.E. of Freyßtadt.

WINHROPE, a poth-town of the province of Maine, in the county of Kennebec, with 1444 inhabitants; 57 miles N. of Portland.

WINHROPE’S Bay, a bay on the N. coast of Antigua.

WINTON, a county of United America, in the state of South Carolina.—Also, a poth-town of North Carolina; 30 miles E. of Halifax.

WINTONIÆ ROTALUS. See Rotulus.

WINTZENBERG, in Geography, a town of Silesia, in the principality of Neisse; 5 miles S.E. of Grotkau.

WINTZENHEIM, a town of France, in the department of the Upper Rhine; 3 miles W. of Colmar.

WINTZIG, a town of Silesia, in the principality of Wohlt; 9 miles E.N.E. of Steinau. N. lat. 51° 27'. E. long. 15° 36'.

WINWEILER, a town of France, in the department of Mont Tonnerre; 24 miles N.E. of Deux Ponts.

WINWOOD, Sir Ralph, in Biography, a statesman in the reign of James I., was born at Aynho in Northampton-shire, about the year 1564, educated at St. John’s college, Oxford, and having passed through several stages of preferment, was chosen proctor of the university in 1592. After having sustained several diplomatic characters and millions, he was made secretary of state in 1614, which office he occupied till his death in 1617. “He was married, and left one son. Sir Ralph was an accomplished gentleman, well acquainted with business, and particularly conversant with commercial and military affairs.” A work, intitled “Memorials of Affairs of State in the Reign of Queen Elizabeth and King James I.,” collected chiefly from the Original Papers of the Right Honourable Sir Ralph Winwood, Knt. &c. &c.” was published in 1725 by Edmund Sawyer, esq. in 3 vols. fol., and contained a valuable record of the political transactions of those times. Biog. Brit.

WINYAH, in Geography, a county of South Carolina.

WINZAAR HARBOUR, a bay on the coast of South Carolina, a little to the N. of the mouth of the Santee. N. lat. 33° 12'.

WINZER, a town of Bavaria, on the Danube; 9 miles S.S.E. of Deckendorf.

WIOCHIST, among the Indian Natives of Virginia, is their priest, who is also generally their physician; and is the perfon in the greatest honour amongst them, next to their king, or great war-captaing. Phil. Tranf. N° 1545.

WIOGRODEK, in Geography, a town of Poland, in Volhynia; 14 miles E.S.E. of Kreminiek.

WIP, a town of Pruffia, on the Curich Haff; 23 miles S.W. of Tiltit.

WIPACH, a town of the duchy of Carniola; 5 miles S. of Hydra.

WIPE, a town of Prussia, in the province of Smaland; 28 miles N.E. of Königberg.—Also, a river of Prussia, which runs into the Curich Haff, 10 miles E.N.E. of Labian.

WIPFELN, a town of the duchy of Wurzburg; 5 miles N.N.W. of Volckach.

WIPPELSPACH, a town of the duchy of Storia; 17 miles S.W. of Voitberg.

WIPPER, a river of Germany, which rises in the county of Mark, about 6 miles S.S.W. of Lunfchede, passes by Wipperfart, Elberfeld, Solingen, &c. &c. and runs into the Rhine, between Cologne and Zons.—Also, a river of Thuringia, which rises 2 miles N. of Dingelstadt, and runs into the Unfrutt, 4 miles N.E. of Kindelbracken.—Also, a river of Pomerania, which runs into the Baltic below Rugerwalde.—Also, a river of Saxony, which runs into the Saal, near Bernberg.

WIPPERAU, a river of Wesphalia, which runs into the Ilmeneau, near Ulten.

WIPPERFURT, a town of the duchy of Berg; 27 miles S.E. of Duffeldorf. N. lat. 51° 5'. E. long. 7° 27'.

WIPPINGEN, a town of Switzerland, in the canton of Friburg; 12 miles S.S.W. of Friburg.

WIPPRA, a town of Wesphalia, in the country of Mansfeld, on the Wipper; 10 miles W.N.W. of Eiflzeben. N. lat. 51° 30'. E. long. 11° 30'.

WIRGEN, a town of Wesphalia, late in the Old Mark of Brandenburg, on the left side of the Elbe; 12 miles N. of Stendal.

WIRENTHAL. See WURTENTHAL.

WIRDOIS, a town of Sweden, in North Finland; 65 miles N.N.E. of Birnberg.

WIRE, in the Mechanic Arts, is a very useful preparation of different metals, in form of a regular and even thread, which can be obtained in very great lengths, and of any required size or shape. Wire is made of any ductile metal, as platinum, gold, silver, copper, brass, zinc, iron, or steel. The process of making wire
wire collides in drawing the piece of metal through a hole in a plate of steel, by which means the metal is rendered of an equal size, and either round or of any other figure corresponding with the figure of the hole in the draw-plate; the metal is thus reduced in size, and at the same time is lengthened in proportion. From the great regularity of wire, and from its toughness and ductility, it is extremely useful to all artificers who work in metal.

The operation is called wire-drawing, and the plate of steel a draw-plate. The machine by which the wire is drawn is called a draw-bench.

The common draw-bench is of a simple structure. A strong plank of wood is fixed on legs, like a floor or bench, fig. 1. Plate Wire. At one end is a roller or axis, A, fixed in a horizontal position, so that it can be turned round by means of four levers, B B, fixed like radii on the end of the axis of the roller. If the resistance is great, the workman applies both his hands and his feet to the levers, to turn them round in the same manner as for a rolling-press. It is usual to have a strong flat, or chain, C, to wrap and wind up round the roller; and at the end of it a pair of pincers, D, are linked; these take hold of the end of the piece of metal, and draw it through the hole in the draw-plate E, which is lodged against two strong iron pins, a a, fixed in the bench, and standing up perpendicularly, so that the plate bears against them.

The pincers are shown in fig. 2. They are adapted to bite the end of the wire; and the inside of the jaws, d d, are cut with teeth like a file, so that they may hold the metal very tight. The opposite ends of the handles are bent in form of hooks at e e; and a triangular link of iron j, which is fastened to the end of the flat or chain C, embraces both hooks e e, and from its triangular figure, it tends to approach the two hooks at the ends of the tongs together; by these means, the strain of drawing the wire closes the pincers, and makes them bite more forcibly in proportion as the wire makes a greater resistance, so that they rarely let the wire slip.

The draw-plate, figs. 3 and 4, is a thick plate of steel, with holes made through it of various sizes, and in a regular gradation from the largest to the smallest. The holes are made large on that side where the wire enters, and they diminish with a regular taper to the other side; the goodnefs of the draw-plate is an object of the first importance. The different holes must diminish by very small gradations, or there will be danger of breaking the wire by forcing it too much at once.

In some draw-benches a rack and pinion are employed, instead of a flat or chain; and a train of wheel-work may be used like that of a crane to obtain a sufficient power. (See fig. 5.) If the workman turns the machine by a winch or handle, it is preferable to four levers, because the motion is more regular; this is of importance for some purposes. Suppose a piece of elastic metal is forcibly drawn through a hole in a plate with a tolerably quick motion, it will be compressed at the moment of passing through the hole; but after it quits the hole, the metal will expand a little. When it is drawn very forcibly, this effect will not take place; for if the compression is continued long enough it becomes permanent: hence, if a piece of large wire be drawn with an irregular motion, first quicker, and then slower, it will be feebly larger at all the parts which pass quickly through the hole, and smaller where it is drawn slowly: if the motion is continued for a few seconds, that part of the wire which remains in the hole will have a ring or indentation round it. This is most obvious in drawing hollow tubes, or copper-wire, which is plated over with gold or silver.

In the machine which is used for drawing strong pieces of metal, and for the very largest, the roller is usually placed in a vertical position, like a capstan, with four levers, at which several men pull, whilst they walk round in a circle to turn the capstan, and wind up the chain which draws the wire through the draw-plate.

A powerful machine of this kind is described in our article Press, for drawing lead-plate through a steel plate.

We have seen a very powerful wire-drawing machine used for forming large hollow tubes of brails or copper, on which the power to draw the tube was obtained by a screw, like that of a press. This power was turned by a train of wheel-work, with a fly-wheel to regulate the motion.

Another plan, which is perhaps the best mode for a very powerful drawing-machine, is to apply the force of the hydrostatic machine originally invented by Pafcal, and revived by the late Mr. Bramah. (See Machine, and Press.) By this means, very large wires for piilion-rods of steam-engines, and other similar pieces, may be rendered straight and true with little expense.

All these machines are confined to draw pieces of metal, which are only a few feet in length, that is, the length of the bench. But when the metal by repeated drawing becomes lengthened into a regular wire, if it is required to reduce it to a still smaller size, it must be drawn through succeeding plates, by wrapping the wire itself upon the roller or barre1, instead of employing a long chain. This method is not applicable at first, because a thick bar of iron could not be made to bend easily round a roller; but when the wire becomes small and flexible, it can be worked very advantageously, and admits of drawing a very great length of wire by a small and commodious machine.

The common wire-mills used in France do not, however, employ a roller or windlass, but the pincers are attached to a lever, which draws them backwards and forwards alternately by the power of the water-wheel.

The pincers are so constructed, that the jaws open when they move towards the draw-plate, and reduce themselves from the wire; but when the pincers are drawn back from the draw-plate, the link causes the pincers to close and bite the wire with such force, that they will draw it through the plate.

A machine of this kind is shown in fig. 7, of the plate. The base of the machine is a very strong log of timber R; one end of it is cut open to receive a wooden lever A B, which moves round an iron pin or bolt a, as a centre of motion; this lever is shaped like the letter L. To the upright arm A of this lever, an iron link C is jointed, and the other end of this link is formed like a ring, to receive the handles of the pincers D. The pincers are supported upon a plate of iron d, which is placed in an inclined position, and there is a groove in the plate, into which the end of the pin or joint of the pincers is received, and they are by that means guided in their motion backwards and forwards: a a are the pins which support the draw-plate E; there are four of them, and the plate is fastened between them by wedges.

The end B of the lever is operated upon by cogs fixed on the axis of the water-wheel, which, as it turns round, depresses the end B of the lever; and the end A pulls the pincers back, and draws the wire through the draw-plate; but when the cogs quit the end of the lever, it is raised by means of a rope fastened to the end of B, and going up to a strong wooden pole fixed on the roof of the building; and it acts as a spring. When the pincers return, they open to release the wire, and slide down the inclined plane d by their own weight, till they are near the draw-plate; the wire being all the time included between the jaws, though
WIRE.

they do not bite. The next cog which seizes the end of the lever draws back the pincers, which immediately close upon the wire, and draw it through the plate.

A wire-mill usually contains three such machines of different sizes; the largest only draws two inches of the wire at each stroke, and makes about forty-eight strokes in a minute; the second machine, four inches; and the third, five inches. This works quicker than the other two, and makes sixty-four strokes per minute. This is a simple machine, but very defective, for much time is lost in the returning of the pincers; they sometimes fail to take good hold of the wire, and they always make deep marks upon the wire at every place where they bite, which are not more than two inches distance in the great wire, and five inches in the smaller.

Fine wire is always made from large wire, by reducing it and lengthening it out by repeated drawings. The large wire is usually manufactured at the wire-mills in the country, and some part of it is reduced to small wire at the same establishments, but more commonly the large wire is bought by those who have occasion for it, and they reduce it by drawing until it becomes as small as it is wanted.

The hand-machine for this purpose, represented in fig. 8, is extremely simple. A is the roller on which the wire is wound up; it turns round upon a vertical pin, fixed in the bench B, and to the upper end a handle C is fixed, for the workman to turn it round; D is the draw-plate, and E is the pin against which it rests. The wire which is to be drawn is put upon a small circular reel F, which turns round upon a vertical pin; this pin is sometimes fixed in the table, or otherwise in a small cask containing flux-water, or beer which has become acid. The use of this is to loosen the oxide from the surface of the wire, for it is necessary to anneal or soften the wire very frequently, by putting it in the fire, and this produces a black coat of oxide on the surface, which will be removed when the wire is again drawn through the plate, and the wire will come out bright and clean. The removal of this oxide will be facilitated by some slightly corrosive menstruum.

Fig. 9. is a very simple and complete wire-drawing machine, to draw three wires at once. A is two rollers or barrels with cog-wheels, TV, on the ends of their axis, which wheels are engaged together. S is a pinion, which is turned round by means of a handle B, and gives motion to the wheels TV. Both these wheels are fitted upon round parts of the axis of their respective rollers, so as to slip or turn freely round upon the same; but a square is formed on the axis outside of the wheel, and a clutch or catch, t or v, is fitted upon this square part, so as to turn always round with the axis. The catch is at liberty to slide upon the axis in the direction of its length, by means of a lever W, which operates upon both catches at once. When either of them is pushed back in contact with the wheel, it intercepts two studds which project from the face of the wheel, and then compels the axis and roller to turn round with the wheel; but when the catch is drawn away from the wheel, then the wheel will slip round upon its axis, without communicating any motion. By means of the lever W, only one wheel can be engaged at once, and the other must be free. The draw-plate E is firmly fixed between the two rollers, and it has a great many holes; the rollers are long enough to receive three wires at the same time. Each roller has a groove in it parallel to the axis, into which a bar of metal is fitted, and will exactly fill it up. When the wires are introduced through the holes in the plate, the ends are laid across this groove; the bar is then put in and fastened by a simple contrivance, and it fastens the ends of the wires beneath it, so that they become attached to the roller; then by turning the handle B round, the two wheels are put in motion in contrary directions; and that wheel which is connected with its axle by its catch, will turn its barrel round, and wind up the wires so as to draw them through the plate E. The other roller being at the same time detached, its wheel is at liberty to turn round in a contrary direction to the wheel, as fast as the wire is drawn off from it. When the whole length of the wires has been drawn through the plate, they are detached from the roller, the ends introduced through smaller holes in the plate, and fastened again to the roller; then the lever W is shifted, to diflodge that wheel which operated before, and engage the other. This being done, the rollers will be turned in an opposite direction, and will wind back the wires, although the handle B is turned the same way round.

After the wire has been thus drawn three or four times, the metal becomes so hard and fibrous, that it would not draw any more without breaking; it therefore requires to be heated in the fire to restore its ductility; for this purpose it must be taken off the barrels. A roller M is provided to wind the wire upon and draw it off from the barrel; this roller is turned round by a handle m, fixed on the extremity of its axis; and the wire which is wound upon it in a coil is clipped off sidewise. This machine is well adapted to be worked by a mill, because the handle may always be turned the same way.

Fig. 10 represents the machine used at the wire-mills for reducing the wire which is to be used for musical instruments, or for making cards for wool and cotton. The rollers A are situated in a vertical position, being fitted on the tops of iron spindles, which are fastened in a vertical position by bearings in the frame of the table or bench. These spindles are kept in continual motion by wheel-work situated beneath the bench, but the spindles are round, so that the rollers A are not turned with the spindles, unless any one of the rollers is lifted up upon the spindle. A crossthread, which is fixed on the top of the spindle, then engages with two projecting knobs fixed in the roller, within a hollow receptacle made at the top of it, and turns the roller round. The draw-plate E is supported by two pins, as before described; and the wire which is to be drawn is wound on a reel, which is put into a cask of flux-water, or beer. The end of the wire, which is put through the draw-plate, is made fast to the roller, which does not turn round as long as it is dropped down upon the spindle; but when all is ready to begin drawing, the roller must be lifted up, and the clutch at the top of the spindle will engage with the two knobs within the hollow at the top of the roller. This puts it in motion, and draws the wire through the draw-plate. The strain of drawing is sufficient to keep the roller up upon the spindle; but as soon as the whole of the wire is drawn through the plate, the resistance ceases, and the roller drops down on its spindle, and becomes disengaged until the workman puts it again in action.

Manufacture of Iron Wire.—Iron is a very ductile metal, but requires a careful treatment in the process of wire-drawing, because it becomes very hard and brittle when the fibres are greatly compressed by repeated drawing. Its ductility must then be restored by heating the wire to redness; this is called annealing; it renders the wire soft, and it will then draw finer and longer; but it will soon require annealing again, and so on.

The iron which is selected for wire-drawing must be of good quality, to bear the requisite extension without breaking. It must be of an uniform substance, without any grains of
WIRE.

of hard or soft parts. The softest iron is not always found
the best, as it will diminish by the strain of drawing it
through the holes alone: and to obviate this, the workman
must draw such iron through a greater number of holes to
obtain the required extension.

The iron is wrought at the tilt-mills from square bars
into round rods of a proper size to commence drawing.
The operation of tilting is nearly the same as tilting of steel.
See that article.) The tilt-hammer for a wire-work
generally makes twenty strokes per minute, and weighs
about fifty pounds. There is also a larger hammer worked
by the same mill, which strikes about 130 times per minute,
and weighs 100 pounds. This hammer is only used for the
first preparation of the iron, or for welding a faggot of
malls together, in order to give the iron a better quality
by a preparation similar to the German steel. To
draw out the iron bars into rods of a proper size to begin
drawing, the workman heats five or eight inches of the end
of a large bar, which comes from the great forge where the
iron is made, and when properly heated he works it regu-
larly under the small tilt, until it is drawn out to a small
and regular round rod of five or six feet in length. A
good workman can thus draw out two hundred weight of
iron in a day, or an ordinary workman one and a half
hundred weight. The loss of metal in the operation is near
6 per cent. by weight.

The small rod, before it is cold, is taken by another
workman, who straightens the rod with a hammer upon an
anvil, then cuts it off, and places the end of the great bar
against the forge. This same workman also superintends
the heating of the iron, and must be very careful not to
overheat it, but to heat the whole regularly.

It is a good practice to pass the iron-rod through a pair
of grooved rollers, the grooves of the two rollers being
opposite, so as to form a round between them. By these
means, the iron may be reduced small, and rendered very
true, previously to beginning the drawing. For common
wire, the whole reduction may be done by the rolling-mill
without a tilt; but the hammer will give a more tenacious
quality to the iron than can be obtained by rolling.

A small round bar, thus prepared, must be drawn through
holes in a draw-plate, by a strong machine with a chain,
or else by the lever-machine, fig. 7. The end of the iron
is first reduced, so that it will enter the hole in the draw-
plate, and pass through sufficiently for the pincers to take
hold. This is done at the forge by a hammer and anvil.
By passing through the plate the iron becomes lengthened,
proportion as it is diminished in size. It must then be
annealed to soften it; the end pointed anew, and again put
through a smaller hole.

The workman who attends the process must study the
nature of the iron, and regulate the manner of drawing ac-
cordingly. This he does by altering the figure of the
hole through which the wire is drawn. The hole must be conical;
the smallest part, being that which acts principally on the
metal, must be at the side of the plate where the wire
comes through. If the taper of the hole is not properly
proportioned, the iron will be strained in drawing; for
though the machine will force it through, grains of harder
metal than the rest of the wire will form themselves, which
will occasion the wire to break when it comes to be much
reduced. This is particularly the case in soft iron. To
avoid this, the hole must be chosen very slightly smaller than
the iron, and must be made with a regular taper. It must
be well supplied with grease, to diminish as much as pos-
ible the friction; and the motion of the draught must be
regulated according as the metal will bear it.

Much depends upon the quality of the draw-plate; al-
though the metal of the plate is sufficiently hard to draw
the wire, it will not refill the blow of a hard steel hammer
and punch. The punch is driven into the hole from
behind, until it enlarges it to the required size and figure.
In

The operation of drawing, the hole becomes gradually en-
larged, and that in a greater degree at the smallest end of
the hole, so that it becomes nearer to a cylinder. To rectify
this, the punch must be applied, or the wire would not pass
regularly; that is, if the same degree of reduction in the size of
the wire was attempted, it would break or strain the wire,
if the hole was cylindrical, although it would pass through
a regular taper hole. The hole sometimes wears irregularly,
and looses its circular figure. In this case, the plate is ham-
mered around the small end of the hole, and the hole is
thereby reduced. The punch is then driven in, to enlarge
it again to the required size: sometimes the punch is intro-
duced at the small end, and then at the large end, as it may
be required to form the hole. In all cases, the punch
must be driven very gently; and after every stroke of the
hammer it must be loosened in the hole, and turned round
before another blow is struck, and without this precaution it
would fix fast in the hole.

The French draw-plates are the most esteemed; and,
in time of war, a good French draw-plate has been sold for
its weight in silver. M. Du Hamel, in Les Arts et Metiers,
vol. xv, gives the following account of the process of making
the draw-plates for the large iron-wire.

A band of iron is forged of two inches broad and one
inch thick. This is prepared at the great forge. About
a foot in length is cut off, and heated to redness in a fire of
charcoal. It is then beaten on one side with a hammer, so
as to work up all the surface into furrows or grooves, in order
that it may retain the substance called the potin, which is
then welded upon one side of the iron, to form the hard
matter on which the holes are to be pierced. This potin
is nothing but fragments of old cast-iron pots; but these
pots which have been worn out by the continued action of
fire are not good: the fragments of a new pot which has
not been on the fire are better.

The workman breaks these pieces of pots on his anvil,
and mixes the pieces with charcoal of white wood. He
puts this in the forge, and heats it till it is melted into a fort
of pate; and to purify it he repeats the fulfion ten or twelve
times, and each time he takes it with the tongs to dip it in
water. M. Du Hamel says, this is to render the matter
more easy to break into pieces.

By these repeated fulotions with charcoal, the cast iron
is changed, and its qualities approach those of steel, but far
from becoming brittle; it will yield to the blows of the
hammer and to the punch, which is used to enlarge the holes.
The bar of iron which is to make the draw-plate is covered
with a layer of pieces of the potin, or cast iron, thus
prepared. It is applied on the side which is furrowed, and
should occupy about half an inch in thicknesses. The whole
is then wrapped up in a coarse cloth, which has been dipped
in clay and water mixed up as thick as cream, and is put
into the forge. The potin is more fusible than the forged
iron, so that it will melt. The plate is withdrawn from
the fire occasionally, and hammered very gently, upon the
potin, to weld and in some measure amalgamate it with the
iron, which cannot be done at once; but it must be re-
peatedly heated, and worked until the potin fixes to the
iron. The workman then throws dry powdered clay upon
it, in order, they say, to soften the potin.

The union being complete, the plate is again heated, and
forged by two workmen, who draw out the plate of one
foot
foot to a length of two feet, and give it the form it is to have. It is well known that cold iron cannot be worked at the forge without breaking under the hammer; but in the present instance, it is alloyed with the iron-bar, and is drawn out with it. It has also acquired new properties by the repeated fusions with charcoal.

The holes are next pierced whilst the plate is hot. This is done with a well-pointed punch of German steel, applied on that side of the plate which is the iron-bar. It requires four heats in the fire to pierce the holes, and every turn a finer punch is employed, so as to make a taper hole. The makers of draw-plates do not pierce the holes quite through, but leave it to the wire-drawers to do it themselves when the plate is cold, with sharp punches, and then they open the hole to the size they desire; and although this potin is of a very hard substance, the size of the hole may be reduced by gentle blows with a hard hammer, on the flat surface of the plate, round the hole.

A great many holes are made in the same plate; and it is important that they should diminish in size by very imperceptible gradations; so that the workman can always choose a hole suitable for the wire he is to draw, without being obliged to reduce it too much at once.

To ascertain the size of the wire, gauges are used. They are commonly made of a piece of wire bent in zigzag, as shewn in fig. 11; and the space between every bend is of a different width; but a better fort is made of a plate-steel, with notches on the edge. (See fig. 12, for the standards.) These should be hardened, that they may not be subject to wear.

Fig. 13, is another kind of gauge, which is very accurate. It consists of two straight rules of steel, put together at an angle. The diameter of the wire is indicated by the depth to which it will enter into the angle; the edges of the rulers are divided into equal parts for that purpose, and numbered, to correspond with the different sizes of wire.

The wire manufacture of Meliffs. Moucheil, situated at l'Aigle, in the department of l'Orne, is one of the most considerable in France. It furnishes annually, in cards for wool-combing only, an hundred thousand quintals of iron-wire, each 1000 lbs. A part of this is consumed in France, and the rest is exported to Portugal, Spain, Italy, and even to the shores of the Levant.

They employ the iron manufactured in the departments of l'Orne and La Haute Saone, as being of the best quality. The first produces the belt wire for making screws, nails, and pins, as much on account of its hardneds as its fine polish, which resembles steel-wire. In this respect, it is superior to the iron of Haute Saone, but from its ductility the latter can now be made extremely fine, and it appears to be most free from heterogeneous particles.

The melted iron, prepared and hammered, being in a state nearly fit for their purpose, is transported, at a small expense, to l'Aigle, by the rivers and canals. They have a forge to reduce the steel and iron of Normandy, which arrives in large pieces, into small and regular bars.

When the iron is formed into an irregular bar of about a centimetre, near four-tenths of an inch in diameter, they begin to draw it into wire. Although it be already much extended by hammering, it is in the first place paffed four times through the drawing-plate; then its molecules become diffused lengthways, and exhibit fibres at their utmost extension. The fibres must be removed by means of heat, which disperse and divides them; and after that the wire may again be reduced three numbers. The fibres which are re-produced by this operation are again removed by heat. The whole process is five times repeated; consequently the wire is paffed through fifteen numbers; after which, a single exposure to the fire is insufficient to fit it for paffing the others, whereby it is reduced to the thickness of a knitting-needle.

The steel-wire, being much harder, requires to be paffed through forty-four numbers, and to be annealed every other time.

The machine which draws the steel-wire must go slower than that which draws the iron; for the firft being very hard, and offering more refiftance to the drawing-plate, should be pulled out with more care, since the quickness ought to be proportioned to the refiftance, and reciprocally; and if they depart from this principle, the results will vary. Thus, for example, the iron of the department de l'Orne, which is more compact than that produced at Haute Saone, if drawn by the same machines, augments in hardness, and is weakened when it is brought to too great a degree of fineness. But this iron, which is very hard, and capable of receiving a very high polish, is to be preferred for certain uses.

In order to anneal the wire, they formerly employed a large and elevated furnace, with bars of caft iron to support the wire in the middle of the flames. It contains seven thousand pounds weight, fo contrived as to contain equal portions of each number. They are so arranged that the thickest wires receive the strongest heat; therefore, the whole is equally heated in the same space of time. The operation lasts three hours, with a fire well kept up, and it might be imagined that this apparatus was completely adapted to the purpose; but there are imperfections in this method, because it leaves the wire exposed to the contact of the atmospheric air, the oxygen of which feizes it with extreme avidity; whence a considerable quantity of oxyd is occasioned, and also an operation to free it from the scales, which confift of beating the bundles of wire with a wooden hammer wetted with water.

Notwithstanding this precaution, there often remains a portion of oxyd adhering to the surface of the metal, which breaks the draw-plate, or fixes on the wire, and gives it a tarnifhed appearance, and causes it to break when it is brought to a great degree of fineness. This furnace is only used for the steel-wire, or the iron from l'Orne, which is liable to change, and besides being harder is not easily attacked by the oxygen.

In order to diminish the waft of the fire, they have contrived another process, which consists in dipping the bundles of wire into a bain of wet clay before they put them into the furnace; and they are left in the furnace to dry before the fire is lighted, without which precaution the clay would peel off from the iron.

For making wire for cards, M. Moucheil invented another furnace. It is round, and about one metre fix decimetres in diameter, and one metre eight decimetres in height, without including its parabolic arch and the chimney above it. The interior is divided by horizontal grates into three stories; the lowest receives the cinders, the second is the fire-place, and into the third or upper place they slide a roleau of wire, weighing one hundred and fifty kilograms, which is inclosed in a space comprized between two caft-iron cylinders, being turned to prevent the admiffion of air between them. The flames circulate about the outside of the first, and within the interior of the second, which defends the wire from atmospheric air. The diameter of the largest cylinder is about one metre four decimetres, that of the second one metre. Thus the space comprized between them is two decimetres, on an elevation of five decimetres. There must be several pairs of cylinders provided; because whilst one
pair is in the furnace another must be prepared to receive a fresh roeale of wire. They are changed every hour by means of a long iron lever, with which a single man can easily push them in and draw them out again, as the cylinder slides on call-iron rails.

They are very careful not to open the cylinders immediately on their being drawn out of the fire; for the roeals of wire contained in them, being still red, would oxidate as much as if they had been heated in the midst of the flames without the least precaution.

The opening contrived for the passage is on the side, and has a door of flat iron, with a groove which winds round the furnace. The fire-place has one something similar to it. That of the shaft-hole is vertical, in order that it may be raised to increase the fire at will.

When the iron-wire is reduced to the thickness of a knitting-needle, it is made up in bundles of 125 kilogrammes (275 pounds) each, into a large iron vessel, in order to anneal it sufficiently to be reduced for the last time. This vessel is placed upside-down in the middle of a round furnace, which is so constructed as to full well burning coals all round it, and of which it consumes 35 kilogrammes (77 pounds) before the operation is completed. The cover must be carefully kept, as the slightest admixture of air is sufficient to burn the exterior surfaces of the wire to an oxyd, which cannot afterwards be reduced.

When one of these vessels is sufficiently heated, it is filled with water, containing three kilogrammes (six pounds and a half) of tartar, and suspended over the flames of the furnace to make it boil. This solution, without attacking the metal, frees it from the grease and the little oxdy that adheres to it. This is the last operation in which the wire is exposed to the fire; and it is then in the proper state for being reduced to the utmost degree of fineness it is capable of fullaining, and will preserve enough of the effect of the annealing to require it no more. But when the natural hardness of the iron varies, this last exposure to the fire should take place in proportion to its thickness. As feel loses its capacity of extension much sooner than iron, it is annealed until it is no thicker than a lewing-needle. The space which is left in the vessel is filled up with charcoal dust, which prevents it from losing the quality of steel, and preserves the heat long enough to give it the proper degree of planity.

As Messrs. Mouchel always use iron and steel of the fame manufactory, they have been able to reduce their operations to a general system; and to attain this end, have determined a graduated scale, by which the wire will not be more fretched in the drawing-plate in one number or size than another. The following is the method they contrived, in order to form this scale for the iron-wire. They take a certain quantity of various thicknesses, which has been drawn as fine as the iron would bear. The smallest size is 100,000 metres (109,333 yards) in length to the kilogramme, 2.2 pounds avoirdupois. They note the weight that each might be capable of supporting without breaking. This being expressed by figures, it is easy, by a few interpolations, to express them in a progressive form. This kind of scale has been partly formed by comparing the weight of the different sizes with equal lengths, from which gauges or calibres may be made for the use of the workmen. These gauges are certain guides, which they cannot mistake except through great carelessness. If they had not these guides they would often pass the wire through holes in the drawing-plate that are too large for it, whence it does not acquire the strength it should have in proportion to its thickness, and loses its hardness. They might also pass it through holes that were too small, which would weaken it, and render it very brittle. In the latter case, it frequently happens that the feel of the drawing-plate, being unable to sustain the force to which it is exposed, will give way, as if the plate were too soft; and the wire will be brittle at the beginning, and soft and too thick at the other extremity.

The greatest part of the fine wire of Messrs. Mouchel's manufactory is drawn by workmen who are differed about the country; but they have also a machine which moves twenty-four bobbins in a horizontal direction, which only requires the workman to look after it. It is upon the bobbins that the wire is reduced to the different degrees of thinness desired; therefore, this is the last operation in the art of making iron and steel wire; although it has all requisite qualities given it in the work-shop of the wire-drawing.

Wire is still incapable of being made into needles and carding-hooks, until it has undergone another operation for d retting or straightening the wire, by which it is made to lose the bend or curve that it acquires on the bobbin.

This work consists in drawing the wire between rails fixed in a piece of wood, and which act to bend the wire, first in one direction, and then in the opposite, in a waving line, by which the waves are at first larger, but decrease gradually, and the last bend of which tends to force the wire into a straight line. The drefler is obliged constantly to adjust the nails, by inclining or raising them with strokes of the hammer. Also for each number of wires the pins must be at different and calculated distances. This requires a workman of intelligence, dili uge, and address.

An ingenious instrument is now appropriated to this operation, and removes all difficulty. Six little puppets or very hard feel are substituted for the nails of the ordinary instrument, and are fixed on parallel bars of metal, so joined together that the movement of them all will be parallel, and the puppets are widened or brought nearer together by screws. The wire is drawn between these puppets in a zigzag or waving line, and the repeated flexures break the fineness of the wire. There is a conductor of the wire to the puppet, and another conductor which serves to prevent the wire from being shaken. There are flight grooves at the extremity of the puppets, to give a passage to the wire. A scale furnished by a screw indicates the distance at which the puppets should be placed from each other, to straighten each size of wire. This forms an irrevorable rule, and the drefler (who may be a child) has a third of the time which is employed in regulating the nalls of the instrument formerly used. There is nothing more to be done than to draw out the wire by means of a wheel, on which he reeels it, and then forms it into bundles to be delivered to the consumers.

The feel-wire of France is proper for many purposes. It is brought from Messrs. Mouchel, for making knitting-needles in the English fashion, shoemakers' needles, and other similar articles. It may also be used for needles of all sizes, and even for cards for wool-combing; but as this feel is much more expensive than the iron-wire, it is very seldom used for the latter purpose.

The method of preparing the draw-plates is described by Messrs. Mouchel, and is different from that before described.

For making wire for cards, two sorts of drawing-plates are used, large and small ones. The first, for the sort of wire that we have been describing, is drawn with the pincers, as fig. 7, and with the bobbin or roller, which is a cylinder adapted to the axis turned by the water-mill, and is used in preference, to avoid the marks made on the wire by the pincers. The small drawing-plates are used for such wire.
WIRE.

as may be drawn by hand. The steel which they employ for these drawing-plates should never vary in quality, except that the smaller plates are made of the finest steel. Several pieces of iron are dipped in the furnace in the form of a box without a lid, their weight being according to the use for which they are intended to be employed.

The workman fills each of these boxes with cast steel, and having covered it over with a luting of clay, it is exposed to a fierce fire until the steel be melted. His art consists in seizing the proper moment to withdraw the plate from the fire; he raises the luting, and blows on it through a tube, in order to drive off all heterogeneous parts, and then amalgamates it with the iron by light blows. After it is cool, he replaces it at the fire, where the fusion again takes place, but to a less degree than before; he afterwards works the steel with light blows of the hammer, to purify and fold it with the iron. This operation is repeated from seven to ten times, according to its quality, which renders it more or less difficult to manage. During this process, a crust forms on the steel, which is detached from it the fifth time of its exposure to the fire, because this crust is composed of an oxidated steel of an inferior quality. It sometimes happens that two or even three of these crusts are formed of about two millimetres, or one-sixteenth of an inch in thickness, which must also be removed.

After all these different fusions, the plate is beaten by a hammer wetted with water, and the proper length, breadth, and thickness, are given to it. When thus prepared, the plates are heated again, in order to be pierced with holes by punches of a conical form; the operation is repeated five or six times, and the punches used each time are progressively smaller. It is of importance that the plate never be heated beyond a cherry-red, because if it receives a higher degree of heat, the steel undergoes an unfavourable change. The plates, when finished, present a very hard material, which nevertheless will yield to the strokes of the punches and the hammer, which they require when the holes become too much enlarged by the frequent passing of the wire through them.

When the plates have been repaired several times, they acquire a degree of hardness, which renders it necessary to anneal them, especially when they pass from one size to another; sometimes they do not acquire the proper quality until they have been annealed several times. Notwithstanding all the precautions which are taken in preparing the plates, the steel will vary a little in hardness, and according to this variation they should be employed for drawing either steel or iron wire; and if the workman who proves them finds they are too soft for either the steel or iron, they are put aside, to be used by the brafs-wire drawers.

A plate that is best adapted for drawing steel-wire is often unfit for the iron; for the long pieces of this latter metal will become smaller at the extremity than at the beginning, because the wire as it is drawn through the plate is insensibly heated, and the adhering parts are swelled, consequently pressed and reduced in size towards the latter end. The plates that are fit for brafs are often too soft for iron, and the effect resulting is the reverse of that produced by a plate that is too hard.

The smallest plates which Messrs. Moucharf use are at the least two centimetres, or eight-tenths of an inch in thickness, so that the holes can be made sufficiently deep; for when they are of a less thickness, they will feize the wire too suddenly and injure it. This inconvenience is much felt in manufactories where they continue to use the plates for too long a time, as they become exceedingly thin after frequent repairs. One of Messrs. Mouchar's large plates reduces 1400 kilogrammes (3280 pounds avoidually) from the largest size of wire to No. 6, which is of the thickness of a knitting-needle; 400 kilogrammes (880 pounds) of this number are afterwards reduced in one single small plate to No. 24, which is carding wire; and to finish them, they are passed through twelve times successively.

For the tenacity of iron wire, see Iron.

The first wire-mill in England was set up by a Dutchman at Sheen, near Richmond, in 1663.

Wires are frequently drawn so fine, as to be wrought along with other threads of silk, wool, or hemp: and thus they become a considerable article in the manufactures. See Ductility.

WIRE, Gold. See Gold-Wire.

Muschellenbroecck records, that an artific of Augsburg drew a wire of gold so slender, that 500 feet of it weighed only one grain; and Dr. Wollafoft, secretary of the Royal Society, has shewn, that a wire of gold may be drawn much finer than this, and that wires of platina may be drawn much more slender, with the utmost facility. Those who draw silver-wire in large quantities for lace and embroidery, sometimes begin with a rod that is about three inches in diameter, and ultimately obtain wires that are so small as 1 of an inch in

thickmess. If in any of these processes a rod of silver-wire is taken, and a hole be drilled through it longitudinally, having its diameter one-tenth part of that of the rod, and if a wire of pure gold be inserted, so as to fill the hole, it is evident that by continuing to draw the rod, the gold within it will be reduced in diameter exactly in the same proportion as the silver; so that if both be thus drawn out together till the diameter of the silver is of an inch, then that of the gold will be only of an inch, and of such wire, 500 feet would be requisite to weigh one grain. In order to remove the coating of silver that surrounds it, the wire must be steeped for a few minutes in warm nitrous acid, which dissolves the silver without any injury to the gold. Dr. W., in his endeavours to make slender gold-wires by the method above-described, found it difficult to drill the central hole in a metal fo fine as silver, and therefore tried whether platina might not be substituted for the gold, as in that case its infusibility would allow its being coated with silver, without the necessity of drilling. Having formed a cylindrical mould one-third of an inch in diameter, he fixed in the centre of it a platina wire previously drawn to the of an inch, and then filled the mould with silver. When this rod was drawn to of his platina was reduced to , and by successive reduction he obtained wires of and , and excellent for applying to the eye-pieces of astronomical instruments, and perhaps as fine as can be useful for such purposes. The extremity of a platina wire having been fulted into a globule near of an inch in diameter, was next hammered out into a square rod, and then drawn again into a wire of an inch in diameter. The fusion was effected by the following simple and easy method suggested by Dr. Marce
Marcet:—A piece of wire, about six inches long, having been bent to an angle in the middle, one half of its length was held in the flame of a spirit-lamp impelled by a current of oxygen; and its extremity was thus fused in about half a minute. An inch of the wire above-mentioned duly coated with silver was drawn, till its length was extended to 182 inches; consequently the proportional diminution of the diameter of the platinum will be expressed by the square root of 182, so that its measure had become

\[
\frac{1}{\sqrt{182}} = \frac{1}{13.5}\;
\]

The specific gravity of the coated wire was assumed to be 10.5, and since the weight of 100 inches was 114 grains, its diameter was inferred to be

\[
\frac{1}{13.5} \times 10 = \frac{1}{13.5}\;
\]

of an inch, and just eighty times of the platina thus contained in it. With portions of the platina wire thus obtained, and successively reduced in diameter, its tenacity was ascertained; and the results of several trials showed in general, that the procés of wire-drawing, which is known to improve the strength of metals within moderate limits, continued also to add something to the tenacity of platina, even as far as

\[
\frac{1}{18,000}\;
\]

before it broke; but the wire in which the experiments were made became then to be impaired by repetition of the operation; so that although he afterwards obtained portions of it as small as

\[
\frac{1}{30,000}\;
\]

in many places interrupted, and he could not rely on any trials of its tenacity. For other particulars with regard to these wires, we refer to the Phil. Trans. vol. ciii. pt. 1.

Wire, Silver, is the fame with gold wire, except that the latter is gilt, or covered with gold, and the other is not. There are also counterfeit gold and silver wires: the first made of a cylinder of copper, silvered over, then covered with gold; and the second of a cylinder of copper silvered over, and drawn through the iron, after the same manner as gold and silver wire.

By 43 Geo. III. c. 68. several duties are imposed on wire imported, as set forth in tables annexed to the act; and by c. 69. fuch duties are laid upon wire made in Great Britain; and by 49 Geo. III. c. 98. new duties are imposed. Every wire-drawer who shall draw any gilt or silver wire, commonly called "big wire," shall take out a licence, for which he shall pay 2l., to be renewed annually on payment of 20l. 24 Geo. III. c. 41. One licence suffices for a partnership. Notice is to be given of working on pain of 20l, and the place of working is to be approved by the commissioners under the same penalty. Wire, and bars for making it, and utensils, found in any private workhouse, of which no notice hath been given, shall be forfeited. Officers shall be permitted to enter and survey, and the penalty of obstructing him is 20l. 10 Ann. c. 26. Preventing him from taking a just account incurs a forfeiture of 100l. 26 Geo. III. c. 77. Just scales and weights shall be kept on pain of 10l. Perfections of false scales and weights forfeit 100l. 10 Geo. III. c. 44. And the same shall be forfeited and fined. 28 Geo. III. c. 37. Ingots or bars of silver, designed for gilt wire, shall be weighed in the presence of the excise officer, before they be covered with gold, and again weighed and marked after the gold is laid on, under penalty of 20l. 15 Geo. III. c. 20.

By 10 Ann. c. 26. an allowance of one-fifth is made for waste in reducing the big wire to small wire. Removing wire before it is surveyed incurs a penalty of 40l.; and unsurveyed wire is to be kept separate, on pain of 10l., and the punishment of concealing wire, &c. is a forfeiture of 20l.

The wire made shall be entered every month, on oath, on pain of 100l. The duty must be cleared off in six weeks after entry, on pain of double duty.

By 15 Geo. II. c. 20 and 22 Geo. II. c. 36. no foreign embroidery, or gold or silver brocade, thread, lace, fringe, or work made thereof, or of copper, brass, or other inferior metal, or gold or silver wire, or plate, shall be imported. And by 10 Ann. c. 26. if any person shall export any gold or silver thread, or lace or fringe made of plate wire spun upon silk, he shall have a drawback after the rate of 5l. a pound avoidipouis, of such silver thread, lace, or fringe, and of 6s. 8d. a pound of such gold thread, lace, or fringe.

For regulations concerning the true making of gilt and silver wire, see the statute 15 Geo. II. c. 20. and for prohibiting the selling or working up of foreign gold or silver lace or thread, see 22 Geo. II. c. 36.

Wire, Brass, is drawn after the same manner as the former. Of this there are divers fizes, suited to the divers kinds of works. The finest is used for the stringing of musical instruments, as spinets, harpsichords, manichords, &c.

The pin-makers likewise use vast quantities of wire of several fizes, to make their pins of. See Pin.

Wire, Iron. See Wire supra.

Wire-Gauze Safety-Lamp, and Safety-Lamp, in the Arts, are lamps constructed to prevent the explosion of inflammable air in mines, by intercepting the communication of the flame on the inside of the lamp with the surrounding atmosphere. The discovery of safety-lamps for this purpose belongs exclusively to our own country, and will form a new era in mining operations. We shall, therefore, state the history of their invention with as much accuracy as possible, amidst the contending claims of the different inventors for priority. The explosions of inflammable air in coal-mines arise from the ignition of carburetted hydrogen evolved from the fritata, and mixed with the atmospheric air that circulates through the mine. These explosions very frequently occasion the most fatal effects, destroying the lives of all the persons employed as well as of the horses, and producing great mischief to the subterranean works. Some mines are much more liable to accidents from this cause than others. In some the carburetted hydrogen accumulates slowly from the want of due circulation; in other mines, it is generated very rapidly, issuing from fissures called blowers, which occur either in the roof, the floor, or the sides of the mine.

In the coal-fields of the Tyne and the Wear, it has been estimated that six hundred men and boys were destroyed in two years by explosions in the mines; but these accidents, unless they took place on a large scale, were as much as possible kept from public notice, partly from the fear of alarming the workmen, and partly from the apprehension of blame to the viewers and managers of the works. Of these melancholy catastrophes, few regilers are kept in any part of Great Britain; but in the year 1810 an explosion took place in a mine in the parish of Felling near Newcastle, which, from the magnitude of the evil it occasioned, excited a general sensation of horror throughout the country. In this mine, the property of wealthy and liberal owners, no expense had been spared in the introduction of machinery and the most approved methods of ventilation. (See Ventilation of Mines.) Notwithstanding this, on the 25th of May
May 1812, the inflammable air exploded in two discharges from one of the pits, which was shortly followed by a third from another pit.

The depth of these explosions under the surface obscured the sound of the reports; but for half a mile round the vibrations of the earth announced the occurrence of the accident before the noise escaped, and an alarm was created by four or five miles round by low and hollow rumblings in the air. Immense volumes of dense vapour and coal-dust, with pieces of wood and coal, were driven high into the atmosphere; and the mangled bodies of several men and boys were absolutely thrown out of the shaft. The country in the immediate vicinity was enveloped in darknese, and every kind of machinery near the mouths of the pits was blown to pieces, or set fire to. Out of a hundred and twenty men and boys employed in the mine only thirty-two were saved, three of whom afterwards died. The coal being set fire to, and the subterranean works blown down or destroyed, the owners were compelled to close the mouths of the pits in order to extinguish the fire; and it was not till the seventh or eighth of the following month that it could be re-opened to extract the bodies, which were, many of them, too much mangled, and in too putrefcent a state, to be identified by the relatives. A series of similar disasters, in each of which from twenty to thirty-five human beings were destroyed, occurred soon afterwards in the same districts, and even in the Telling mine another explosion took place in December 1813, by which twenty-three men and boys and twelve horses were killed. The only method that had been adopted to prevent explosions, besides the usual modes of ventilation for clearing the mine, was the substitution of steel-mills for candles.

The steel-mill is an instrument for producing light by the collision of flint and steel; it consists of a wheel whose diameter was about five inches in diameter, with fifty-two teeth, which works a pinion with eleven teeth. On the axis of the pinion is fitted a thin jagged steel wheel, from five to six inches in diameter; against the circumference of this wheel the sharp edge of a flint is fixed, and the toothed wheel has a handle, which is turned by a boy; the whole machine being fixed in an iron frame furnished by a leather belt. The steel wheel revolves with great velocity, and elicits a stream of incensions, which give a considerable light. Where the mines were supplied with inflammable air, these machines were used; but besides affording only an imperfect light, and being difficult to manage, many instancies had occurred of the air igniting from the incisions of steel-mills. For the purpose of exploring the unworked and more dangerous parts of the mine, the steel-mill was both an inconvenient and incomplete instrument; but until the year 1809 no method of lighting had been attempted which might supersede its use.

About that time Dr. Reid Clanny, a scientific and ingenious physician at Sunderland, commenced a series of experiments, with a view to infuse the gas which might explode in a lamp, and cut off its communication with the surrounding air in the mine. With this intent, he contrived a lamp in which the combustion of the oil or tallow is supported by the ordinary air of the coal-mine supplied by a pair of bellows, and passing through a flaring or reservoir of water below the light; at the same time, a portion of the air already in the lamp is driven through another reservoir in the upper part above the light, and thus the air supplied may explode within the body of the lamp without communicating the flame to the external air, however highly it may be charged with carburetted hydrogen gas. The moment the air enters the lamp it comes in contact with the flame, and consequently only a small portion of it can be exploded, instead of the whole contents of the lamp; by this means several obvious advantages are secured. The air passing in a brisk current close by the flame carries the smoke with it, so that the light is always clear and steady. The other parts of the lamp were air-tight, and the whole made very strong, with a glass nearly half an inch thick to prevent it from being broken by any common accident. It is capable of being managed by a boy at a much less expense than the steel-mill. This lamp, which, for strength and for security from explosions and accidents, exceeds any other that has since been invented, excited little attention among the coal-workers where it was first made known. Had not the prejudices against improvements prevented its general introduction, more than one hundred lives might have been preserved, which were destroyed in the mines of the Tyne and Wear. In several other mining districts accidents have been prevented by the introduction of lamps, which have been adopted as a necessary provision for each individual; and in those districts where the lamp is not employed, the hospitals are crowded with cases of accidents from the explosion of the coal-gas.

In Plate I. fig. 2. Geology, is given an outline of the lamp on its original principle, which, though less portable, is, we consider, the safest that has yet been employed. A is the body of the lamp, constructed of copper or block-tin; B, the upper part of the lamp, ending in a conical bent tube, by which the air is discharged after supporting combustion through the water-cylinder C and D, the part D being filled with water to keep the lamp cool, if necessary; E, the window of the lamp, made of glass; F, the candle, supported on a tin flange; G, a cylinder containing water, through which the air is forced by the bellows; H, a tube from the bellows, which conveys air to the lamp. A flexible leather tube may be fixed to the valve of the bellows, to fend atmospheric air from a distance, if necessary. If the lamp be in order, it is scarcely possible to conceive any inflation of the flame more perfect than it presents; and to Dr. Clanny must be allowed the undoubted claim of priority in having first directed the attention of miners to a method of avoiding danger before unknown, and of showing practically how it might be effected. In the improvement which Dr. Clanny made in this lamp afterwards, to render it more portable, (see fig. 3. in the same plate,) a is the tube fixed to the lamp, and which conveys the air; b, the oil-cylinder; c, the aperture, under the burner of the oil; d, the flexible tube connected with the bellows; e, f, the glasses. In both these lamps, the air being supplied by bellows, required the constant attention of a boy; this, however, was the case with the steel-mills, which were in general use before. A lamp that would supply itself with atmospheric air was still a desideratum; when Dr. Clanny discovered, in November 1815, as he was making experiments with the original safety-lamp in an atmosphere of fire-damp
WIRE-GAUZE SAFETY-LAMP.

in the Horrington mine, near Sunderland; that if the infalation of the lamp were made with hot water, the fire-damp burned silently at the wick, and did not explode within the lamp, as formerly. This he ascertained to be owing to the ream; and he farther discovered, that one part in volume of ream to two of the most exploitive mixtures destroyed their inflammability. A similar effect of ream had been before noticed by Von Grothus, in the 82d volume of the Annales de Chimie, but had not been applied to any useful purpose. In December of the same year, Dr. Clancy constructed a ream safety-lamp, which he exhibited to the Society, for preventing accidents in coal-mines, and received their unanimous thanks; and in 1817 he received a gold medal from the Society of Arts for the discovery.

In the ream safety-lamp there is a reservoir of water at the top of the lamp, which is a closed tin box, or cistern. The water is kept boiling by the flame of the lamp, and the ream mixing with the carburetted hydrogen prevents all risk from explosion. The air is supplied through a tube to the upper part of the cistern above the water, and descends, mixed with the flame, down two other tubes, into the body of the lamp. By this means, the fire-damp burns silently and steadily at the wick of the lamp alone for any length of time. Should the carburetted hydrogen exceed the proportion of atmospheric air for supporting combustion, the light is extinguished, but this can rarely happen. It has also the valuable property of keeping cool throughout every part, and under all circumstances; this is effected by the evolution and motion of the ream.

This lamp, says Dr. Clancy, is now well known to burn most brilliantly in an atmosphere of fire-damp, even after the original safety-lamp had has the fire-damp exploded within it. The ream-lamp has now been extensively used in several of the northern collieries. Its great recommendation over other inventions is the superior light which it affords. These lamps are made of the strongest tinned iron, with a flat glass in front, three-eighths of an inch in thickness. They are exceedingly strong and durable, and cost about twelve shillings, but might be manufactured on a large scale for half the price.

Fig. 4. represents the short tube by which the air enters into the tube b, and this tube supports the water-cistern e at the top, being fitted into the tube a at the bottom, so as to be taken out and replaced when the water is to be poured in or removed from the cistern e. The air which ascends the tube b mixes with the ream of the water-cistern, and passes down the two tubes d, d, to support the combustion of the flame, and afterwards ascends by the side of the cistern through the chimney of the lamp. These tubes are closed at the bottom, and perforated on the sides, to retard the progress of the air, and mix it with the ream before it reaches the flame. The bottom is air-tight; f the glass, and g the oil-lamp. These lamps are twelve inches in length, exclusively of the chimney. They should be cleared of water, and well dried, after they have been in use, that they may be more durable. When the lamp is first lighted it is necessary to establish a current, which is done by turning the lamp, so that the tube a may be exposed to the current of air; this will be effected in five minutes, and the lamp will afterwards continue to burn regularly and steadily.

Dr. Clancy farther applied the same principle to the construction of a larger lamp, in which were three wicks to burn the inflammable air as it was made to issue through the oil; this is intended to confine the hydro-carburetted gas as it rushes from a blower.

In the history of useful inventions, perhaps no instance of simperness can be adduced, among those interested in any dif-covery, which equals the inattention shewn for several years by the coal-workers in the north to the valuable labours of Dr. Clanny. We had an opportunity of examining his lamp in 1813, and were satisfied with the complete security which it affords. At that time, however, so far from receiving the patronage he highly merited, he was regarded by many with a strange jealousy, as an officious intruder into the mysteries of mining; mysteries which he had no right to investigate. To Dr. Clanny, however, the first discovery of a safety-lamp is undoubtedly due; and we have no hesitation in asserting our belief that his original safety-lamp is the most fecure of any that have since been invented, where dangerous parts of the mine are to be explored, on account of its more complete infallation, and its greater strength. His lamp had also the merit of first suggesting the possibility of inflating the flame in the different lamps which have since been constructed.

The attention of the public was at length directed to the dangerous situation of the men working in the mines by a few gentlemen, who formed a society, in 1815, at Sunderland, entitled A Society to prevent Accidents in Coal-Mines. Dr. Gray, rector of Bishop-Wearmouth, an active member of this society, invited Sir H. Davy, in 1815, who was then on a visit in the north of England, to examine the collieries with a view to afford the efforts of the society to prevent the accidents to which they were subject. From the information communicated to him by persons employed in the mines, he was induced to commence a series of experiments on carburetted hydrogen gas, which led to several unexpected results, not less interesting to science than useful in their application to the arts. Before proceeding to describe these, we must notice the labours of Mr. Stephenson, an engineer in the Killingworth main colliery, who previously to this time had, as he informs us in a pamphlet on the subject, entitled "A Description of the Safety-Lamp invented by George Stephenson," made the discovery that inflammable air will not explode through small apertures. In the same pamphlet he states, that a lamp constructed by him on this principle was tried in the above colliery on the 21st of October 1815, the lamp being carried in safety into a part of the mine where a strong blower of inflammable air was inflating. The experiment, he adds, was immediately repeated in the presence of two persons employed in the works.

These lamps, judging from Mr. Stephenson's own description, yielded but a feeble light. They were afterwards improved; but these improvements bear to cloe resemblance to parts of Sir H. Davy's lamp, hereafter to be described, that we conceive Mr. Stephenson must labour under no small difficulty in establishing his claim for their original invention. The question, at present agitated with much warmth, can only be decided by a reference to well-established dates and authentic evidence; an investigation not suited to the nature of the present work.

We have little doubt that the inflation obtained in Dr. Clanny's lamp by water first suggested to Mr. Stephenson the possibility that small apertures might intercept the extension of the flame as effectually as water. On this suggestion his first lamp appears constructed, the tube which admitted the air being covered with a slide to diminish the aperture at pleasure; but the quantity of air which could be safely admitted through one aperture being inadequate to the support of the flame, it was obvious that the only way to ensure the air in both light and safety was to increase the number of apertures, diminishing the size of each. In this manner, it appears that Mr. Stephenson proceeded mechanically, without a correct knowledge of the properties of the gas, or the principles on which the effects were produced. We think, however, that
that as an approximation to a valuable discovery, Mr. Stephenson's lamp entitled him to the patronage and support which he has received. It ought also to be recollected that Dr. Clanny and Mr. Stephenson both laboured under the disadvantage of living at a distance from the residence of ingenious practical mechanics to execute their inventions in the most simple, cheap, and portable manner; an advantage only that could be obtained in the neighbourhood of the metropolis, or of large mechanical manufactories.

Sir H. Davy, after ascertaining that the fire-damp, or inflammable air in coal-mines, is the light carburetted hydrogen gas, as stated by other chemists, proceeded to examine accurately its combustibility and explosive nature. When one part of fire-damp was mixed with one of common air, the mixture burned on the approach of a taper, but did not explode. Two of air and three of fire-damp produced similar results. When four parts of air and one of fire-damp were exposed to a lighted candle, the mixture being in the quantity of six or seven cubic inches in a narrow-necked bottle, the flame descended to the bottom, but there was no noise. One part of gas inflamed with six parts of air in a similar bottle, producing a slight whistling found. One part of gas with three of air rather a louder sound. One part with ten, eleven, twelve, thirteen, and fourteen parts, still inflamed, but the violence of the combustion diminished. In one part of gas and fifteen parts of air, the candle burned without explosion, with a greatly-enlarged flame. The same effect was observed, but in a gradually diminishing ratio, as far as thirty parts of gas to one of common air. The mixture which seemed to perform the greatest explosive power was seven or eight parts of air to one of gas; but the report produced by thirty cubic inches of this mixture was less than that produced by one-tenth of a mixture consisting of two parts of common air and one of pure hydrogen.

It was also very important to ascertain the degree of heat required to explode the different mixtures of fire-damp. A common electrical spark, he found, would not explode five parts of air and one of fire-damp, though it exploded six parts of air and one of the latter gas. Very strong sparks from the discharge of the Leyden jar seemed to have the same power of exploding different mixtures of the gas, as the flame of a taper. Well-burned charcoal, ignited to the strongest heat, did not explode any mixtures of the gas; and when a fire of the same charcoal, which burned without flame, was blown to whiteness by an explosive mixture without producing inflammation. An iron rod at a red or even at a white heat did not inflame explosive mixtures of the gas; but when in brilliant combustion it produced that effect.

The flame of gaseous oxides of carbon, as well as of olefiant gas, exploded the mixtures of the fire-damp.

In respect of combustibility, says Sir H. Davy, the fire-damp differs materially from the other common inflammable gasses. Olefiant gas, when rendered explosive by a mixture of common air, is fired both by charcoal and iron, heated to a dull redness. Gaseous oxides of carbon, which explodes with two parts of air, is likewise inflammable by hot iron or charcoal. And hydrogen, which explodes when mixed with three-sevenths of air, takes fire at the lowest visible heat of iron or charcoal; and the flame is the flame with carburetted hydrogen.

The importance of these experiments is too obvious to require illustration. Having ascertained the above facts, Sir H. Davy proceeded to examine the degree of expansion of mixtures of fire-damp and air during their explosion, and likewise their power of communicating flame through aperturest to other explosive mixtures. It is to this latter part of Sir H. Davy's experiments and its application to safety-lamps, that the controversy respecting the priority of the discovery refers.

When six parts of air and one of fire-damp were exploded over water by a strong electrical spark, the explosion was not very strong; and at the moment of the greatest expansion, the volume of the gas did not appear to be increased more than one-half. In exploding a mixture of one part gas from the distillation of coal, and eight parts of air in a tube one-quarter of an inch in diameter, and one foot long, more than a second was required before the flame reached from one end of the tube to the other, and he could not make any mixture explode in a glass tube one-seventh of an inch in diameter; and this gas was more inflammable than fire-damp, as it consisted of carburetted hydrogen mixed with some olefiant gas.

In exploding mixtures of fire-damp and air in a jar, connected with the atmosphere by an aperture of half an inch, and connected with a bladder by a stopcock having an aperture of about one-sixth of an inch, the flame passed into the atmosphere, but did not communicate through the stop-cock so as inflame the mixture in the bladder; and in comparing the power of tubes of metal and those of glas, it appeared that the flame passed more readily through tubes of glas of the same diameter, and that explosions were flopped by metallic tubes of one-fifth of an inch, when they were one inch and a half long; and this phenomenon probably depends upon the heat lost during the explosion, in contact with so great a cooling surface, which brings the temperature of the first portions exploded below that required for firing the other portions.

Metal is a better conductor of heat than glas; and it has been already shown, that the fire-damp requires a very strong heat for its inflammation.

A mixture of the gas with air, he also found, would not explode in metallic canals or troughs when their diameter was less than one-seventh of an inch, and their depth considerable in proportion to their diameter, nor could exploitations be made to pass through such canals.

Azote and carbonic acid, even in small proportions, diminished the velocity of inflammation in explosive mixtures of fire-damp. Azote, when mixed in the proportion of one to five of an explosive mixture containing twelve of air and one of fire-damp, deprived it of its power of explosion, when one part of azote was mixed with seven of an explosive mixture only, a feeble blue flame passed through it.

One part of carbonic acid to seven of an explosive mixture deprived it of the power of exploding; so that its effects are more remarkable than those of azote, probably in consequence of its greater capacity for heat, and probably likewise of its higher conducting power connected with its greater density.

The consideration of these various facts, Sir H. Davy informs us, led him to adopt a form of lamp in which the flame, being supplied with only a limited quantity of air, should produce such a quantity of azote and carbonic acid as to prevent the explosion of the fire-damp; and which, by the nature of its apertures for giving admittance and exit to the air, should be rendered incapable of communicating any explosion to the external air.

If in a close lantern supplied with a small aperture below and another above, a lighted lamp having a very small wick be placed, the natural flame gradually diminishes, till it reaches at a point at which the supply of air is sufficient for the combustion of a certain small quantity of oil; if a lighted taper be introduced into the lantern through a small door
WIRE-GAUZE SAFETY-LAMP.

Door in the side, which is instantly closed, both lights will burn for a few seconds, and be extinguished together.

A similar phenomenon occurs; if in a clove lantern supplied with a quantity of air merely sufficient to support a certain flame, a mixture of fire-damp and air is gradually admitted, the first effect of the fire-damp is to produce a large flame round that of the lamp, and this flame consuming the oxygen which ought to be supplied to the lamp, and the standard of the power of the air to support flame being lowered by the admixture of fire-damp and by its rarefaction, both the flame of the fire-damp and that of the lamp is extinguished together; and as the air contained a certain quantity of azote and carbonic acid before the admission of the fire-damp, their effect by mixing it is such as to prevent an explosion in any part of the lantern.

In an experiment which sir H. Davy made, to ascertain that the flame was extinguished in the lantern, though the mixture was still explosive which supplied the flame, the lantern was placed on a stand under a large glass receiver standing in water, which was of sufficient capacity to enable the candle to burn for some minutes. A quantity of fire-damp was thrown in from a bladder, so as to render the atmosphere explosive. As the fire-damp mixed with the air, the flame of the taper gradually enlarged till it half filled the lantern; it then gradually diminished, and was suddenly extinguished without the slightest explosion. The air in the receiver was found after the experiment to be highly explosive.

Sir H. Davy then introduced into a glass jar, containing an explosive mixture of one part fire-damp and ten parts of air, a lighted lantern, to which air was supplied by two glass tubes one-tenth of an inch in diameter, and half an inch long. The taper burned at first with a feeble light, the flame soon became enlarged, and was then extinguished. These experiments were several times repeated with a constancy of result. It is evident, he says, from hence, that it is only necessary to use air-tight lanterns supplied with air from tubes or canals of small diameter, or from apertures covered with wire-gauze, placed below the flame, through which explosions cannot be communicated, and having a chimney at the upper part on a similar system for carrying off the foul air.

This principle sir H. Davy adapted to a variety of glass lanterns, in which the air was admitted through small apertures or wire-gauze, with a top protected by the flame. These lanterns, however they might have answered for experiments in the laboratory, were not, however, well fitted for practical use; for besides the fragility of common glass, which exposed the miner to explosions from the enlargement of the flame, the glass was liable to become heated and to break, however strong it might be made. This inconvenience was, however, removed by the substitution of a cylinder of fine wire-gauze, forming a clove lamp or lantern, into which the air is admitted, and from which it passes through very small apertures. In the first experiments, the wire was of brafs the one-hundredth part of an inch in thickness, and the apertures were not more than the one-fortieth part of an inch; this was found to stop explosions as well as the long tubes or canals, and to admit a free current of air. The wire-gauze lamp, in its present improved form, is the mostimple and portable that has yet been introduced. Plate V. fig. 5. Geology, represents the lamp as at present used; a represents the single cylinder of wire-gauze; the foldings a a a must be very well doubled and fastened by wire. If the cylinder be of twilled gauze, the wire should not be less than one-sixtieth of an inch in thicknesses, and from twenty-eight to thirty both warp and weft; b represents the second top, which fits upon a; c represents a cylinder of brafs, in which the wire-gauze is fastened by a screw, to prevent its being separated from the lamp by any blow; d is fitted into a female-ferrow, which receives the main-ferrow b of the lamp, furnished with its safe-trimmer h, and safe-feeder for oil f.

Lamps on the same principle were constructed, in which the cylinder is made of copper of one-fortieth of an inch in thicknesses, perforated with longitudinal apertures of not more than one-sixtieth of an inch in length, and the one-thirtieth in breadth. (See Plate I. fig. 6. Geology.) In proportion as the copper is thicker, the apertures may be increased in size. This form of the lamp may be proper where such an instrument is only to be occasionally used, but for the general purpose of the collier, sir H. Davy states that wire-gauze is much superior from its flexibility, and the ease with which new cylinders are introduced.

To this lamp a valuable addition has been lately made by the application of a lens before the flame, to condense the rays of light, and direct them to any particular spot. It has the farther advantage of protecting that part of the wire-gauze from coal-dust, by which it is liable to be choked and obscured in a few hours.

In subsequent experiments, sir H. Davy discovered that much thicker wires and larger apertures might be used than were at first applied. This gave to the lamp greater strength, and transmitted more light.

Gauze made of brafs wire one-sixtieth of an inch in thicknesses, and containing only 100 apertures in the square inch, did not communicate explosion in a mixture of one part coal-gas and twelve of common air, so long as the wire was cool; but as soon as the top became hot an explosion took place. A quick lateral motion also enabled it to communicate explosion. With 196 apertures to the square inch, the explosion was not communicated till the wire became strongly hot.

Iron wire-gauze, containing 240 apertures to the square inch, was safe in explosive mixtures of coal-gas, till it became strongly red-hot at the top.

Iron wire-gauze, of 576 apertures to the square inch, or the one-fortieth part of an inch each in diameter, appears, says sir H. Davy, to be safe under all circumstances, in explosive mixtures of coal-gas. With very fine wire-gauze, mixtures of oxygen and hydrogen gases may be burned without explosion until the brafs wire begins to melt.

The explanation which sir H. Davy gives of the effect of wire-gauze, and small tubes in averting the progress of flame, is as follows:—These results are best explained by considering the nature of the flame of combustible bodies, which in all cases must be considered as the combustion of an explosive mixture of inflammable gas, or vapour and air; for it cannot be regarded as a mere combustion at the surface of contact of the inflammable matter: and the fact is proved by holding a taper, or a piece of burning phosphorus, within a large flame made by the combustion of alcohol; the flame of the candle, or of the phosphorus, will appear in the centre of the other flame, proving that there is oxygen even in its interior part.

The heat communicated by flame must depend upon its mass: this is shown by the fact, that the top of a slender cylinder of wire-gauze hardly ever becomes dull-red in the experiment on an explosive mixture; whilst in a larger cylinder made of the same material, the central part of the top soon becomes bright-red. A large quantity of cold air thrown upon a small flame, lowers its heat beyond the
and in extinguishing a flame by blowing upon it, the effect is probably produced principally by this cause, assisted by a dilution of the explosive mixture.

If a piece of wire-gauze sieve is held over a flame of a lamp, or of coal-gas, it prevents the flame from passing it, and the phenomenon is precisely similar to that exhibited by the wire-gauze cylinders: the air passing through is found very hot, for it will convert paper into charcoal; and it is an explosive mixture, for it will inflame if a lighted taper is presented to it; but it is cooled below the explosive point, by passing through wires even red-hot, and by being mixed with a considerable quantity of air comparatively cold. The real temperature of visible flame is, perhaps, as high as any we are acquainted with. Mr. Tennant was in the habit of shewing an experiment which demonstrates the intensity of its heat. He used to fuse a small filament of platinum in the flame of a common candle; and it is proved by many facts, that a stream of air may be made to render a metallic body quite hot, yet not be itself luminous.

A considerable mass of heated metal is required to inflame even coal-gas, or the contact of the flame mixture with an extensive heated surface. An iron-wire of \( \frac{1}{27} \) th of an inch, and eight inches long, red-hot, when held perpendicularly in a beam of coal-gas did not inflame it, nor did a short wire of one-sixth of an inch produce the effect held horizontally; but wire of the same size, when six inches of it were red-hot, and when it was held perpendicularly in a bottle containing an explosive mixture, so that heat was successively communicated to portions of the gas, produced its explosion.

A certain degree of mechanical force, which rapidly throws portions of cold explosive mixture upon flame, prevents explosions at the point of contact. Thus, on pricking an explosive mixture of coal-gas from a syringe, or a gum elastic bottle, it burns only at some distance from the aperture from which it is diffused.

Taking all these circumstances into account, there appears no difficulty in explaining the combustion of explosive mixtures within, and not without the cylinders: for a current is established from below upwards, and the hottest part of the cylinder is where the results of combustion, the water, carbonic acid, or azote, which are not inflammable, pass out. The gas which enters is not sufficiently heated on the outside of the wire to be exploded; and as the gages are no where confined, there can be no mechanical force pricking currents of flame towards the flame point.

Two papers by Sir H. Davy, connected with this subject, were afterwards published in the Philosophical Transactions for 1817, entitled "Some Researches on Flame." In these papers, a number of new and extremely interesting experiments on the properties of flame are detailed. The practical application of the results to safety-lamps we shall briefly state, as they explain more clearly the principle on which their safety depends, and the circumstances essentially requisite to their proper construction. Sir H. Davy commends the paper by informing us, that the intensity of the light of flames depends principally upon the production and ignition of solid matter in combustion; and that the heat and light in this process are in a great measure independent phenomena: and he afterwards defines flammable to be gaseous matter, heated so highly as to be luminous, and that to a degree of temperature beyond the white heat of solid bodies, as is shown by the experiment; that air not luminous will communicate this degree of heat; for if we hold a fine platinum wire one-twentieth of an inch from the exterior of the middle flame of a spirit-lamp, and conceal the flame by an opaque body, the wire will become of a white heat in a space where there is no visible light.

When an attempt is made to pass flame through a very fine mesh of wire-gauze at the common temperature, the gauze cools each portion of the elastic matter that passes through it, so as to reduce its temperature below that degree at which it is luminous; and the diminution of temperature must be proportional to the smallness of the mesh and the mass of the metal. The power of a metallic or other tiffue, to prevent explosion, will depend upon the heat required to produce the combustion, as compared with that acquired by the tiffue; and the flame of the most inflammable substances, and of those that produce most heat in combustion, will pass through a metallic tiffue that will intercept the flame of less inflammable substances, or those that produce little heat in combustion. Or the tiffue being the same, and impermeable to all flames at common temperatures; yet when heated it will become permeable to each different kind of flame at different temperatures: those which produce most heat will most readily pass through it. A tiffue of one hundred apertures to the square inch, made of wire of one-sixtieth inch, will, at common temperatures, intercept the flame of a spirit-lamp, but not that of hydrogen; and when strongly heated will no longer arrest the flame of the spirit-lamp.

The ratio of combustibility of the different gases is to a certain extent proportionate to the masses of heated matter required to inflame them. Thus, an iron-wire of one-fortieth of an inch heated cherry-red will not inflame olefiant gas, but will inflame hydrogen gas: and a wire of one-eighth of an inch heated to the flame degree will inflame olefiant gas: but a wire of one-five-hundredth part of an inch must be heated to whiteness to inflame hydrogen.

These circumstances will explain why a mesh of much finer wire is required to prevent the explosion from hydrogen and oxygen from passing; and why so coarse a texture of wire is sufficient to prevent the explosion of the fire-lamp, the least combustible of the known inflammable gases.

The following experiments afford a satisfactory and simple explanation of the cause of the stoppage of flame by the wire-gauze lamp. Let the smallest possible flame be made by a single thread of cotton immersed in oil, and burning immediately on the surface of the oil; it will be found to be about one-thirtieth of an inch in diameter. Let a fine iron-wire one-hundred-and-eightieth part of an inch be made into a circle of one-tenth of an inch in diameter, and brought over the flame. Though at such a distance it will instantly extinguish the flame if it be cold; but if it be held above the flame, so as to be slightly heated, the flame may be passed through it without being extinguished. The effect depends entirely on the power of the metal to absorb the heat of the flame. This is shown by bringing a glass capillary ring of the flame diameter and size over the flame: this being a much worse conductor of heat will not extinguish it even when cold. If its size, however, be made greater, and its circumference smaller, it will act like the metallic wire, and require to be heated to prevent its extinguishing the flame.
surface, by diminishing the fize or increasing the depth of the aperture, all flames, however rapid their motion, may be arrested. Precisely the same law applies to explosions acting in clofe vessel: very minute apertures, when they are only a few in number, will permit explosions to pass which are arrested by much larger apertures, when they fill a whole surface. A small aperture was drilled at the bottom of a wire-gauze lamp, in the cylindrical ring which confines the wire-gauze; this, though less than one-eighth part of an inch in diameter,扩张ed the flame, and fired the external atmosphere, in consequence of the whole force of the explosion of the thin flatum of the mixture included within the cylinder driving the flame through the aperture; though, had the whole ring been composed of such apertures, it would have been perfectly safe. Nothing, says Sir Humphrey Davy, can demonstrate more decidedly than these simple facts and observations, that the interruption of flame by solid tisues permeable to light and air, depends on no con- dite or mysterious cause, but to their cooling powers simply considered as such.

When light, included in a cage of wire-gauze, is introduced into an explosive atmosphere of fire-damp at right angles, the maximum of heat is soon obtained, the radiating power of the wire and the cooling effects of the atmosphere, more efficient than from the mixture of inflammable air, preventing it from ever arriving at a temperature equal to that of dull redness. In rapid currents of explosive mixtures of fire-damp, which heat common gauze to a high temperature, twisted gauze, in which the radiating surface is considerably greater and the circulation of air less, preserves an equal temperature. Indeed the heat communicated to the wire by combustion of the fire-damp in wire-gauze lamps is completed in the power of the manufacturer, for by diminishing the apertures, and increasing the mass of metal, or the radiating surface, it may be diminished to any extent. One important circumstance, however, is not here adverted to by Sir Humphrey Davy; by increasing the thickness of the wire and diminishing the aperture, the quantity of light transmitted is greatly reduced, and its power of illumination rendered nearly inefficient. Hence the power of the manufacturer to construct a lamp perfectly safe and sufficiently luminous must be limited by certain conditions. However, Sir Humphrey Davy informs us, he has lately had lamps made of thick twisted gauze formed of wires the fourtieth of an inch, sixteen to the warp and thirty to the weft, which being rivetted to a screw cannot be displaced, from its flexibility it cannot be broken, and from its strength cannot be crushed, except by a very strong blow.

From some very ingenious experiments on the combustion of inflammable substanies at low temperatures, Sir Humphrey Davy discovered that a coil of platina wire, one-eighth of an inch thick, remains at a white heat when the quantity of coal-gauze is increased so as to extinguish the flame of the lamp; hence he has suggested the advantage of producing a coil of such wire into the safety-lamp, but we do not learn that it has yet been found of practical use. An account of these experiments is given in the Phil. Trans. for 1817.

The principal objections to the use of wire-gauze safety-lamps in mines, and also to other safety-lamps, may be briefly stated; namely, the accidents to which the lamps are unavoidably subject, and the accidents which may arise from negligence in the use of them; the injury to the health of the men, from remaining in explosive mixtures of fire-damp longer than they would have done before the introduction of these lamps into mines; and lastly, the temptation they present to neglect the more expensive methods of ventilating mines, and trusting too much to the securitv of the lamp. The accidents which may happen to the lamp from one or more of the meshes being broken, when made of such slender wire, and exposed to the corrosive effects of mineral waters in the mine, or the rapid oxidation from moisture alone, must be very frequent, independently of accidents from the falling of pieces of coal on the lamp. The breaking of a single wire being sufficient to enlarge the aperture and occasion an explosion, it is obvious that extreme caution is required in the use of the lamps, and a careful inspection of them should be made every day before they are delivered to the men. This we understand is done in extensive collieries, a person being appointed for the sole purpose of inspecting and trimming the lamps. The accidents which may arise from the negligence of a single man, in extensive mines where more than fifty or one hundred persons are employed, are left easy to guard against; the lives of a great number are constantly depending on the carefulness of each person; and, however perfect the instrument may be, no one can feel perfectly safe when the air in the mine is in an explosive state. Some of the lamps were at first so constructed that they could not be opened except by the key of the inspector; but we believe this precaution is not generally introduced, the great object being to get the lamps made as cheap as possible. We conceive, however, essential to the security of the miners, that the lamp should be closed by a lock, to prevent the men from uncovering the flame. The lamp itself, by the enlargement of the flame, gives due notice when the air of the mine is in an explosive state, and at such times the proper remedy is to be sought in ventilation; for we conceive it to be neither wise nor humane to suffer the men to continue working in an explosive atmosphere, unless under particular circumstances. Should the invention of safety-lamps induce coal proprietors to allow their workmen to remain for a longer time inhaling the fire-damp, or lead them to neglect the only permanent security, that of efficacious ventilation, we should consider the discovery as injurious to the interests of humanity. It would, however, be extremely unfair to decree the merit of any invention from the possible misuse of it. Were coal-mines first opened in a district where they had never before been worked, we believe there in most cases it would be prac- tical to secure a constant and safe ventilation through all the works: but in districts like those on the Tyne and the Wear, there are numerous old excavations remaining filled with impure air, of which the present miners have little knowledge, having been worked out in remote periods. Any communications accidentally opened with the old workings may suddenly fill a mine with a mixture of fire-damp, in which case the safety-lamp offers the only means of security with which we are acquainted. For viewing the old workings or adits of the mine, which cannot be approached with a common lamp or candle, the safety-lamp is the most invaluable instrument, and in all cases where the fleet- mill was formerly used it affords a far more secure and convenient light. Though we have thought it necessary to state the objections which may be urged against the safety-lamp, we conceive that they apply principally to the mine of it; and the following statement made by Sir Humphrey Davy offers the most satisfactory proof of its utility. "The case has now been (Jan. 1817) for twelve months in the hands of hundreds of common miners in the most dangerous mines in Great Britain, during which time not a single accident has occurred where it has been employed, whilst in other mines much less dangerous, where it has not been adopted, some lives have been lost, and many persons burned."

The farther experience of another year, on a more extended
tended scale, has fully confirmed the conclusions to be drawn from the above statement, and we may justly consider the safety-lamp as one of the most valuable presents which philosophy has made to the useful arts.

Wire-Grates, in Gardening, are contrivances formed of fine wire-work, and used for keeping various kinds of large insects out of vineeries, hot-houses, and such places, as being very mischievous to the fruit in them.

Wire-Heels, &c., a defect and consequent disease in the feet of the horse or other animal. Some, as Gibbon, think that narrow heels are for the most part a natural defect, but that they are often rendered incurable by bad shoeing. Some, in shoeing, hollow the quarters so deep and so thin, it is said, that one may almost pinch them in with one's fingers, and think by that means to widen them out by a little broad-webbed shoe; but this turns them narrow above and curvus their heels, and dries up or rots the frog. The best way in all such cases is, it is supposed, not to hollow the foot in shoeing, and to pare nothing out but what is rotten or foul. If the foot be hard or dry, or inclined to be ragged, it may be bathed often with chamber-ley; or two pounds of linseed bruised may be boiled in two quarts of chamber-ley to the consistence of a poultice, then adding to it six ounces of soft-soap, and the foot be softened with it every day, rubbing a little of it upon the sole; or, a composition formed of two ounces of bees-wax, six ounces of hog's-lard, one ounce of tar, and linseed oil as much as will make it into the consistence of a smooth ointment, may be mixed together, and be used daily in the same manner as the foregoing poultice.

The diseases and affections of the feet of these animals have of late been more accurately understood, and better means of relief and cure recommended.

In the case of narrow or contracted heels, attended with inflammation, and moistly confined to the fore-feet, there is great pain; the animal is constantly moving its legs, and generally inclined to lie down. When first taken out, it is almost incapable of performing any of the paces; the weight being too much thrown on the hinder legs. In trotting, the legs are fearfully lifted above the surface of the ground; the flaps are very short, and a walk or canter is gone into instead of any other pace. In the gallop, the weight of the body is thrown on the fore-part of the foot; and in trotting, on the heels; which produce very considerable pain, on account of the action of the foot being confined to the quarter in a backward direction.

The disease is mostly caused by improper shoeing, very great and hard exercise, standing in confined situations on litter, and many other such causes.

In effecting a cure in all the more fresh cases of this sort, where the variation from the natural round form of the hoof is not considerable, it may be accomplished without the animal being entirely made to rest, by removing the shoes, and if possible reducing the heels on a line with the inferior part of the frog. The sole parts may be thinned, and that portion which is between the bars of the foot and the crust be hollowed out. The hoofs should likewise be thinned with a proper tool, especially at the quarters. The shoes should be put on again for two or three weeks in such cases, and the parts from near the coronet to the fetlock be anointed with a blistering liniment, composed of half an ounce of finely-powdered cantharides and four ounces of Barbadoes tar, well mixed together.

And when necessary, three or four pints of blood may be taken from the plate vein, and a rowel be put in the cheet.

Mlasses, containing nitre in the quantity of an ounce, are to be occasionally had recourse to. At the same time, the feet of the animal should be put in a trough of warm water for two or three hours every day, so filled as just to cover the hoof-parts of them; gentle walking or trotting exercise being used on such ground as is soft.

Afterwards the shoes which are made use of should be thinner at the heels than those which were taken off, the heels fitting well and firmly on the bars and crust. The patent frog may be used when the animal is at rest, as by continuing its use in a proper manner, the foot will gradually regain its natural form and action. See Frog.

In such cases, too, the coronet may now be bathed every day with an emulsion composed of an ounce and a half each of marsh-mallow ointment and Barbadoes tar, with half an ounce of spirit of turpentine, well incorporated together; which will promote and hasten the growth of the hoof-part of the foot.

In cases in which the animal has been lame some length of time, and the contraction of the heels is very considerable, it should be put in moist pasture-grounds, to run for some time, carefully lowering the heels every four or five weeks, or oftener if necessary. As soon as the hoof has been elongated from the coronet to the sole, the cure will be completely effected; which will in most cases be accomplished in the course of about five months; at the end of which time the animal will have regained an entirely new circular foot of the natural shape. The animal should then be shod with thin-heeled shoes, which admit the frog-part of the foot to rest upon the ground.

In cases in which the animals cannot be turned out in this manner, they should be provided with a large hard building, well clayed on the bottom part, and preferred soft and moist by the occasional application of water slightly over it.

But though this sort of management may modify recover and restore the natural shape of the foot, the proper action of it is, not restored with such facility. In a great number of cases, the feet become so much altered, in their structure and power on account of the long-continued inflammation, that the means of expansion are wholly destroyed; as is often the case in the cartilages that are situated at the higher and hinder part of the foot, which not unfrequently become bony, and, of course, it becomes impossible to regain the action of the foot. As in these cases, the more the foot is exposed, the greater will be the injury and mischief afforded; the only means of relief that can be made use of, is the covering of the foot with such a shoe as is calculated to prevent concussion, which may be accomplished by the application of a har-shoe that will rest on every part of the crust, and not upon the frog-part of the foot. This is supposed to be the best form of shoe that can be used for the purpose.

In these cases, when the animals are at rest, the feet should be flopped with an ointment, composed of one ounce and a half each of common turpentine and tar, and two ounces and a half of mallow ointment, well mixed together.

In the cases of cracks or separations of the fibres of the hoofs in a perpendicular manner, which when they extend to the coronet are often very troublesome; the animals most liable to them, are those which have either long brittle hoofs or narrow heels. Blood animals of the horse kind are more subject to them than others.

In the management and cure of them, the parts around the cracks should be made thin by the rasps, when the firing silver should be drawn over above and below them, to the extent of the fissures, in order to prevent their extension. It should
should likewise be carried over the cracks, by which means a slight quantity of tenacious moisture will exude, and glue up the separated parts; which may be covered over with an ointment composed of four ounces of marshmallow ointment, and two ounces of common turpentine, spread upon tow, and kept on the parts by bandages.

The animals should have bar-shoes, which may rest firmly on the frogs, and be made hollow in the parts opposite to the seats of the complaints, in order that no prejudice may be given to those parts of the feet; rest being given for some days, and then only moderate exercise allowed, until the cracks have descended towards the lower parts of the feet. The coronets and hoofs may be bathed twice a day, as in the above cases of contracted heels, in order that the growth of horn may be promoted. By the use of these means, the animals moitly soon get better.

Wires of Alteries, in Natural History, a name given by authors to a sort of extraneous stuff belonging to the alteries, and being a sort of branches from the body of that column.

Wire of Lapland. The savage inhabitants of Lapland have a sort of shining slender substance in use among them on several occasions, which is much of the thickness and appearance of our silver wire; and is therefore called, by those who do not examine its structure or substance, Lapland wire.

The people of this miserable country find many uses in every thing nature has afforded them, and, among the rest, that species of stag called the rein-deer, which is the most frequent animal among them, is not only serviceable in furnishing them with meat, clothes, houses, and the means of carriage and travelling; but its bones make many of their most necessany utensils; and the sinews, which are all carefully separated in the eating, are, by the women, after soaking in water, and beating, spun into a sort of thread, which is of admirable fineness and strength, when wrought to the smallest filaments; but when larger, is very strong, and fit for the purposes of strength and force. Their wire, as it is called, is made of the finest of these threads, covered with tin. The women do this busines, and the way they take it is to melt a piece of tin, and placing at the edge of it a horn with a hole through it, they draw these finewy threads, covered with the tin, through the hole, which prevents their coming out too thickly covered. This drawing is performed with their teeth, and there is a small piece of bone placed at the top of the hole, where the wire is made flat, so that we always find it rounded on all sides but one, where it is flat.

This wire they use in embroidering their clothes as we do with gold and silver; and they often sell it to strangers, under the notion of its having certain magical virtues. Scheffer, Hist. Lapland.

Wire-Worm, in Agriculture, a most mischievous worm in different sorts of grain-crops. It has been described by Birkander, in the Swedish Tranactions, as having in the grub-state a yellow colour, with the head brown, and the extremities of the jaws black; the body confluted of twelve joints, shining, and hard-skinned; when it changes its skin it is for some time white; a few hairs are scattered here and there, but mostly upon the head and last joint; under the three first joints are six horns and pointed feet, and at the beginning of the last joint, which is round, there are two black spots, one on each side, which are, probably, apertures through which it breathes.

It is considered by some, notwithstanding the almost general opinion of farmers to the contrary, that the disease of wheat-crops, which is attributed to this insect or worm, depends upon some other cause, as a fault in ploughing, by which the land is left in too light, open, and porous a state or condition, and which prevents the young plants from being fully and properly nourished, and consequently from forming their roots in a proper manner in the ground. And this notion is in some measure supported by the circumstance of the benefit which is afforded by rolling, treading, and otherwise comprefling the land.

It has been proved and shewn by many different trials, that this worm is one which is extremely tenacious of life, and consequently not easily destroyed or got quit of by any means which have yet been made use of for the purpose.

Wire, in Geography, one of the smaller Orkney islands, separated from Roosay by a strait called Wire Sound, about three-quarters of a mile in breadth. N. lat. 58° 58'; W. long. 2° 51'.

Wire. See Wires.

Wiredy, a town of Sweden, in the province of Smaland; 16 miles N. E. of Jonköping.

Wireda, a town of Sweden, in the province of Smaland; 26 miles S. W. of Wexio.

Wiri, two small islands in the gulf of Finland. N. lat. 59° 50'. E. long. 27°.

Wiring, among Animals, the operation of putting a sharp-pointed wire up the nostrils of a sheep, so as to pass up into the brain, and produce a discharge in cafes of the impure, firm, or vertigo. It seems, however, a dangerous remedy, though it is said to have been successful in curing the diseace in many cases.

Wiring Fruit-Tree, in Gardening, the operation and practice of palling a fine wire round their branches, in order to bring on the fruiting state.

Wirkowenes, in Geography, a town of Poland, in the patalitane of Kiev; 44 miles W. N. W. of Bialocekiew.

Wirksworth, an ancient market-town in the wapentake of the name, in the county of Derby, England, is situated near the southern extremity of the mining district, in a valley nearly surrounded by hills, at the distance of 14 miles N. W. from the county-town, and 140 miles N. W. by N. from London. In the year 815, the manor belonged to the abbey of Repton; after the destruction of that monastery by the Danes, it became willed in the crown, to which it appertained at the time of taking the Domesday-survey. King John granted it to William de Ferrers, earl of Derby. Having been forfeited by the attainder of earl Robert in 1265, it was granted, together with the wapentake, by Edward I. to his brother, Edmund, earl of Lancaster; and has ever since formed part of the earldom or duchy of Lancaster. It is now held under the duchy by Richard Arkwright, esq. A market on Wednesdays, and a fair of three days, were granted for this town to Thomas, earl of Lancaster, in 1305. The market is now held on Tuesday, chiefly for butcher's-meat, butter, eggs, and pedlar's ware; the corn-market is small. Four annual fairs are now held. The town-hall, a handsome brick structure, was built in 1773, by the direction of Thomas, lord Hyde, the chancellor of the duchy. In this hall are held courts-baron for the manor, courts-leet for the wapentake, and barrow-courts for regulating the mines and mineral concerns. The church, a spacious edifice, apparemly of the fourteenth century, consists of a nave and side-ales, a north and south transept, a chancel, and a square tower, supported by four large pillars. In the church-yard is a grammar-school, founded in 1576, by Anthony...
Anthony Gell, esq. who endowed it with lands which now produce 170l. per annum. He also founded an alms-houfe for fix poor men, to which he gave a rent-charge of 20l.; this has been augmented by subfequent benefactions. In the town was formerly a meeting-houfe for Presbyterians, but it is now occupied by a congregation of Independents. Here are also chapels for Baptiftis and Wesleyan Methodists. In the population return of the year 1811, the inhabitants of this town are enumerated at 3474, occupying 777 houses. The parish of Wirkworth is extensive, and includes, besides the town, fourteen townships or villages, some of which are very populous.—Beauties of England and Wales, vol. iii. Derbyshire. By J. Britton and E. W. Brayley, 1803. Lyfons’ Magna Britannia, vol. v. Derbyshire, 1817.

WIRNAU, a town of the county of Henneberg; 5 miles S.E. of Smalkaldein.

WIRRAL, or WIREHALL, a strip of land in the county of Chelfter, extending from the city of Chelfter to the sea, between the rivers Dee and Merfey.

WIRREY, or ST. ANDREW, one of the Shaint islands. N. lat. 57° 53'. W. long. 6° 19'.

WIRSAM, a town of Sweden, in the province of Smaaland; 46 miles N.N.W. of Calmar.

WIRSTBERGHOSTZEN, a town of Welfphalia, in the bishopric of Hildefeim; 8 miles S. of Hildefeim.

WIRSUNG, JOHN GEORGE, in Biography, was a native of Bavaria, studied medicine at Padua, and was a disciple of Vefling. In 1642 he published the discovery of the pancreatic duct, with which his name is connected; and in the following year he was affiliated by a Dalmatian, under the influence of a paflion excited by having been silenced by him in a public disputation. Haller, Éloy.

WISANGI, in Geography, a town of Sweden, in Welf Bothnia, on the Tornea; 95 miles N.N.W. of Tornea.

WISBADEN, a town of Germany, in the principality of Naflau Saarbruck Üffen. This town is known to the Romans, and the Heidenfiehe Mann, or Heathen Wall, which runs through the prefent town of Wilbech, appears to be a work of that nation; and a part of the boundaries of this town are derived from the linned trenches thrown up by Druftus, oppofite to Mentz, for the covering of the Rhine. In the days of the kings of the Franks, in this town was a royal court. At Wilbech are fome medicinal springs, formerly in great repute; 5 miles N.W. of Mentz. N. lat. 50° 3'. E. long. 8° 9'.

WISBECH, a large market-town in the county of Cambridge, England, gives name to a hundred and a deanery, and is situated in the extreme northern part of the county, about 30 miles N. from Ely, 42 from Cambridge, and 90 from London, in the fame direction. Wilbech is a great mart for corn, about 100,000 quarters being annually exported from thence by the river Oufe, and the canals communicating with Cambridge, Lynn, and other towns. Other articles of export are rape-feed and long wool, of which great quantities are sent to the Yorkshire clothiers. Timber, from Northamptonshire, is also embarked for the service of the navy. The principal imports are, coal, deals, and wine. The river is navigable up to Wilbech, at spring-tides, flowing fix or eight feet, for vessels of 60 tons, which are continually employed in the corn trade, to London, Hull, and other ports. Prior to the Norman Conquest, Wilbech belonged to the convent of Ely. In 1071 William of Normandy erected a caflle of flone at the town; but this being dismantled, a new caflle of brick was built on the feite, between 1478 and 1483, by Morton, bishop of Ely, and which became the epiftcopal refidence. Being purchased by fecretary Thurloe during the interregnum, it was rebuilt after designs by Inigo Jones. Reverting at the Restoration to the fee of Ely, it was sold fome years ago, and on the ground of the detached buildings fome good houses have been erected. The church is a spacious, hand-fome fabric, although of a fingular construcfion, having two naves and two fides. The naves are lofty, and feparated by light flender pillars, with pointed arches; the fides, which are the moft ancient, are divided from their repective naves by low mafy pillars and femicircular arches. The tower of the church is beautiful, and notwithstanding the antiquity attributed to it, is proved by records to have been erected posterior to 1520. Wilbech, with the adjacent country, has frequently fuffered by inundations, particularly in 1256, when great numbers of small craft, cattle, and men, were destroyed. In 1637, by a breach in the bank of Wilbech fen, upwards of 4000 acres of land were overflowed. But the greatest deviations of this kind occurred in Nov. 1613, by the fpring-tide concurring with a violent N.E. wind; and in March 1614, by the melting of the snow in the country. In 1611 the inhabitants obtained a renewal of their charter, which constituted them a body corporate, by the ftyle of the burgeffes of Wilbech; but the right of the election of the ten capital burgeffes was limited to the poiffeffors of freeholds of the value of 40s. per annum. The executive officer, the town-baillift, although a person wholly unknown to the charter, has the entire management of the elates and affairs of the corporation. The annual income under the management of thefe capital burgeffes, allotted to public and charitable purposes, amounts to about 800l. A principal objeét of this charge is the maintaining of beacons and buoys, and the clearing of the channel of the river Oufe or Wif, from which the town takes its name; precautions highly neceffary, on account of the shifting fands between the town and the fea. Among the improvements made in Wilbech of late years, must be mentioned the flone bridge of one elliptic arch, and the new cloth-foufe. The freams are paved, lighted, and watched, at the expense of the corporation. The trade of Wilbech has much increafed of late years, through the improved state of the drainage and navigation of the fens. The neighbouring lands are in high cultivation, and are chiefly appropriated to grazing. The sheep and oxen grow to a great fize; and confiderable numbers are fent off twice every week to London. The inhabitants are almost wholly employed in commerce, the town poiffeffing no kind of manufacture, although the surrounding country produces vast quantities of wool, hemp, and flax. The canal, opened not many years ago, extending from Wilbech river to the river Nene at Outwell, and thence to the Oufe, affords a communication with Norfolk, Suffolk, and the western counties, and which proves very beneficial to the town. In 1781 a literary fociety was eftablisht in Wilbech, and the education of youth is provided for by a free-school, and by two charity-schools, supported by subscription. The diffenters from the eftablisht church are not numerous, but have their repective places of worship. The parih, containing 6306 acres, is in the greatelt part a very rich arable and paffure land. In 1676 the inhabitants of Wilbech were computed to be 1705; in 1801 they amounted to 5004; and in 1811 to 6300: the inhabited houses were 1237.—Beauties of England; Cambridgeshire. By J. Britton and E. W. Brayley, 8vo. 1802. Magna Britannia, by the Rev. D. Lyfons and S. Lyfons, 4to. 1868.
The moral sense, as several new melodies, modulations, and happy licences, which we used to think entirely of his invention, upon an attentive examination of their works, appear to have been first suggested by the three fellow-students. Yet, what they had slightly and timidly touched, Purcell treated with the force and courage of a Michael Angelo, whose abilities rendered the difficult easy, and gave to what, in less powerful hands, would have been distention, facility, and grace.

Dr. Boyce has printed six verse and full anthems, by Wife, which are admirable; and in Dr. Tudway’s collection, Brit. Mus., there are seven more, and a whole service in D minor.

He was author of the celebrated two-part song, “Old Chiron thus preached to his pupil Achilles,” which is still too well known to need an encomium here.

Michael Wife was killed in a street-fray at Salisbury, by the watchman, in 1687.

The first movement of his verse-anthem for two voices, “The ways of Zion do mourn,” is more beautiful and expressive than any grave and pathetic composition for the church of other countries, of the same kind and period of time, that we have hitherto discovered.

The use which the author has made of harmonic intervals at the word mourn, is not only happy and masterly, but new, even now, at more than a hundred and twenty years distance from the time when the anthem was produced! The whole composition seems to us admirable; and besides the intelligence and merit of the design, the melody is truly plaintive, and capable of the most touching and elegant expression of the greatest fingers of modern times; the harmony too and modulation are such as correspond with the sense of the words, and enforce their expression.

There is an elegance of phrase in a passage of the second movement of the preceding anthem, at the word down, which has been lately revived, and in great favour, with a very minute difference, among the first fingers of Italy. The difference consists only in pointing the first note if a crotchet or quaver, and making the second and third notes semiquavers or demisemiquavers.

Wife was a native of Salisbury, in which cathedral he was appointed organist and master of the choristers, in 1668; and in 1675, a gentleman of the chapel royal. In 1686, he was preferred to the place of almoner and master of the boys at St. Paul’s. He is said to have been in great favour with Charles II., and being appointed to attend him in a progres, claimed, as king’s organist for the time, the privilege of playing to his majesty on the organ, at whatever church he went.

Wise Men of Greece, Seven, in the History of Philosophy, an appellation given to several eminent men, on whom was bestowed the praise of civil and moral wisdom. The history of these persons, originally without doubt plain and simple, has been rendered obscure and uncertain by traditionary reports. The incident to which this appellation was at first owing was as follows:

In the third year of the 49th Olympiad, it happened that certain youths of Ionia, purloining from a fisherman of Melitus a large draught of fish, which he had brought to shore, found in the net a golden tripod of great value. Upon this a dispute arose between the fisherman and the purchasers: the former maintaining that he had only sold them the capture of fish; the latter asserting that they had bought the chance of the draught, whatever it might be. The question was referred to the citizens of Miletus, who were of opinion, that in an affair so extraordinary, the Delphic oracle
 oracle should be consulted. The answer of the oracle was
'To the Wiseft.' In obedience to this answer, the Mi-
leans unanimously adjudged the tripod to Thales. Thales
modestly declined the honour intended him by his fellow-
citizens, and sent the tripod to Bias, a wife man of Priene;
from him it was passed on through several hands, till it came
to Solon, the Athenian legislator, who judging that the
character of 'the wiseft' could not properly belong to any
human being, sent the prize of wisdom to Delphos to be
dedicated to Apollo. The story, as above related, has in it
something fabulous; and the circumstances that attend it are
differently related by different writers. It is more probable,
says Brucker, that in some public assembly a tripod was pro-
posed as an honorary prize to the man who should recite, in
verse, the most excellent maxims of political and moral wis-
dom, and that the fages who engaged in this generous con-
test afterwards agreed to dedicate the prize to Apollo.
In confirmation of this conjecture it is alleged, from a paffage
in Plato's Protagoras, that the wife men of this period met
together to frame concise precepts and maxims for the con-
duct of life, and agreed to fend such sentences as were
thought most valuable to Delphos, to be inscribed in the
Temple. Hence Apollo is said by the ancients to have been
the author of the precept 'Know thyself.'— E cdeo
defedtum, Γνῶθι σεαυτόν.' The names commonly included
under the appellation of the Seven Wise Men of Greece are,
Thales, Solon, Chilo, Pittacus, Bias, Cleobulus, and
WISECK, in Geography, a river of Hefe, which runs
into the Lahn, near Gieffen.
WISELL, a town of the duchy of Stiria; 4 miles
N.E. of rein.
WISEMAN, Richard, in Biography, was first known
as a surgeon in the civil wars of Charles I., and accom-
panied prince Charles, when a fugitive, in France, Hol-
lund, and Flunders. He served for three years in the Spanish
navy, and returned with the prince to Scotland, and was made
prisoner in the battle of Worecefter. After his liberation, in
1652, he settled in London. When Charles II. was re-
stored, he became eminent in his profession, and was made
one of the sergeant-surgeons to the king. In May 1676 he
appears, from the preface to his works, to have been a suf-
ferrer by ill health for twenty years; but the time of his
death is not known. The refult of his experience appears
in 'Several Chirurgical Treatises,' fol. 1676, 1686, and
in 2 vols. 8vo. 1710. The subjects of these treatises are,
tumours, ulcers, diseases of the anus, king's-evil, wounds,
gunshot-wounds, fractures and luxations, and lues venerea.
The course of his practice comprehended more than 600
cafes, of which he gives apparently an honest account,
recording his failures as well as his cures, and the detail merits
attention. In his relation of the miraculous effects of
the royal touch in ferfcola, it is not easy to reconcile his
honesty with his sagacity, though from his own narration,
duly considered, the fallacy is easily detected. His writings
have long been regarded as a standard authority in the exa-
WISEMAN, Mr., a worthy English musician, who went
early in life to Italy, in order to receive lessons on the
violin from Tartini, in Padua, who recommended him, in
1736, to one of his favourite scholars, Padghmo Bin,
at Rome, where, after some time, finding himself likely
to thrive as a professor, by the patronage of the English
nobility and gentry with which that city always abounds
in their travels, settled there for the reft of his life; and
though not a performer of the first clafs, being a good
musician, and a man of probity and good conduct, he was
not only respected by his countrymen, but by the natives of
that city, which, though no longer the capital of the world,
is still the capital of Italy and the fine arts.
Mr. Wiseman had refided fo long in Italy, that he had
almost forgotten his native tongue. In 1770 he lived in
the Palazzo Rafeale, without the gates of Rome, where, during
the firft winter months, he had a weekly concert till the
opera began. It was here that the great Raphael lived and
died, where there were still some of his paintings in fresco,
and where the late duke of York, the prince of Brunfwick,
and several other great personages, gave concerts to the firft
people of Rome.
WISEN, in Geography, a river of Baden, which runs into
the Rhine, near Bâle.
WISEENT, a river of Bavaria, which runs into the Red-
nitz, near Forchheim, in the bishropic of Bamberg.
WISEPPE, a town of France, in the department of the
Meffe; 3 miles S. of Stenay.
WISEFTARD, a town of Sweden, in the province of
Småland; 22 miles N. of Carlferona.
WISHTAFT, a town of Sweden, in the province of
Sonderborgh, 38 miles W. of Småland.
WISIR, a small island in the East Indian Sea, near the
coast of Aroo. S. lat. 15° 21'. E. long. 134° 50'.
WISK, or WIS, a river of England, in the county of
York, which runs into the Swale.
WISKA, a river of Sweden, which runs into the sea,
3 miles S. of Waro, in West Gothland.
WISI, a town of Bohemia, in the circle of Beraun;
4 miles N. of Pribiram.
WISLAMF, a river of Wurtemberg, which runs into the
Rems, N. E. of Schorndorff.
WISLITZA, a town of Poland, in the palatinate of
Sandomirz; 48 miles W. S. W. of Sandomirz.
WISLOCH, a town of the duchy of Baden, in the
palatinate of the Rhine; 14 miles E. of Spire, N. lat. 49° 18'.
E. long. 8° 45'.
WISMAR, a town of the duchy of Mecklenburg,
situated in a bay of the Baltic, with a good harbour; large,
well fortified, and defended by a citadel. This is one of
the best and largest places in the country; as, besides fix
churches, it has also a particular columbia of its own, with
a grammar-school, under the direction of eight masters, and
is the seat of a Swedish court of justice, erected in the year
1623, both for the district and the Swedish Anterior Pomera-
nia. The court consists of a president, a vice-president, and
four aldermen. It was formerly a Hanse town, and possessed
of the privilege of coinage; the first origin is not known
with any degree of certainty. In the year 1288, it was en-
larged; and in the year 1266, obtained the Lubek rights.
In the year 1261, it was annexed to the duchy of Schwerin;
in the year 1627, the imperialists got possession of it; but
in the year 1632 were driven out by the Swedes, to whom it
was ceded, at the peace of Weildphalia, in 1648, 33 miles
E. of Lubecc. N. lat. 53° 55'. E. long 11° 26'.
WISMOATH, a town of Austria; 14 miles S. of Even-
furth.
WISNA, a town of the duchy of Warfaw; 70 miles
N. E. of Warfaw.
WISNUM, a town of Sweden, in the province of War-
mland; 25 miles E. N. E. of Carolstadt.
WISOKIA, a town of Lithuania; 20 miles N. W. of
Brzece.
WISP, in Rural Economy, a term signifying a small bunch of
of straw which is used in rubbing horses down. Wisp is also a term sometimes applied to a rowel or feton put in animals.

WISPEL, in Commerce, a corn measure in Germany. A half of wheat contains 3 wipels; and a half of oats only 2 wipels. See Scheffel.

WISSANT, in Geography, a town of France, in the department of the Estaits of Calais; 12 miles N. of Boulogne.

WISSING, William, in Biography, was born at Amsterdam in 1656. He received instructions in the art of painting from Donndyns, an historical painter at the Hague, but on leaving that master went to Paris, and in the year 1660, came to England, and assisted Lely in his numerous works. After Lely's death, he became rather a favourite, and promised to become a formidable rival to Kneller. He drew all the royal family, and was particularly favoured by the duke of Monmouth, whose portrait he painted several times. The duke of Somerset also patronized him, and employed him to paint himself and his duchesses, and the pictures are now at Petworth.

Willing was appointed principal painter to James II., and was sent by him into Holland, to paint portraits of William and Mary. He did not long survive his return to England, and died at Burleigh, the seat of the earl of Exeter, in 1687, at the age of 31. His heads were painted with finish and delicacy, in a style quite distinct from that of his master, Lely, or his rival, Kneller; too soft, indeed, for character; and his larger pictures lack composition and harmony, both in line and colour.

WISSOKY-MEYTO, in Geography. See Hohen-Maut.

WISSOWATIUS, Andrew, in Biography, a Socinian divine, was born of a noble family in Lithuania, in 1668, educated in the New Unitarian college at Racow under Crelius, and for some time pursued his studies at Leyden, strictly adhering to the principles of his tutor. Finding, on his return to Poland, that his brethren suffered persecution from the diet of Warlaw, he exerted himself courageously in their defence, and encountered many personal difficulties and sufferings in the exercise of his ministry in various parts of Poland. He was not silenced by the decree issued against Unitarians in 1658, but leading an unsettled life, he was industrious in seizing every opportunity that occurred for making proselytes. In 1665, he was the only person of his party who was present at the "Colloquium Charitatum," where he firmly maintained his opinions against the jealou Chichovius and others. He is said to have refined large bribes, as well as to have encountered severe trials, in maintaining his sentiments. Removing to Hungary, he spent two years in learning the language so as to be able to instruct and fortify his brethren in that kingdom. Lived at all he retreated to Holland, where he was employed in superintending the publication of the "Bibliotheca Fratrum Polonorum," in 9 vols. fol., and where he died in 1678. His integrity and constancy are highly applauded by the historian of his sect; his writings were numerous, and one of them, published after his death, was entitled "Religio rationalis, feu de Rationis judicio in controversiis, etiam theologicos ad religiosos adhibiendo, tractatus." Gen. Biog.

WISSOWITZ, in Geography, a town of Moravia, in the circle of Hradisch; 20 miles E.N.E. of Hradisch.

WIST, WISTA, a quantity or measure of land among our Saxon ancestors; of different dimensions, in different places. In the Monastic, it is said to be half a hide, or sixty acres; in an old chronic of the monastery of Battle, it is said to be forty-eight acres.

WIST, in Geography, a town of Sweden, in the province of Earl Gotland; 6 miles S.S.E. of Linkoping.

Vol. XXXVIII.
the least difference, thereby to avoid being milled by simili-
tude, and, by affinity, to take one thing for another: and
hence he accounts for the reason of that common obser-
vation, that men who have much wit and prompt memories,
have not always the clearest judgment, or deepest reason.

It is the metaphor and allusion wherein, for the most part,
confists the entertainment and pleasantry of wit; which
strikes in so lively a manner on the fancy, and is therefore
so acceptable to all people, because its beauty appears at
first sight, and there is required no labour of thought, to
examine what truth or reason there is in it. The mind,
without looking any farther, reeds satisfied with the agree-
able effects of the picture, and the gaiety of the imagination;
and it is a kind of affront to go about to examine it by the
severe rules of truth, or reason. Whence it should only,
that wit confits in something that is not perfectly conform-
able to them. Effay on Human Underit. b. ii. c. xi. f. 2.

Professor Dugald Stewart (Elem. of the Philosophy of
the Human Mind, p. 302.) adds to Locke's definition of
wit, that it implies a power of calling up at pleasure the
ideas which it combines; and he inclines to believe, that the
entertainment which it gives to the hearer is founded, in
a considerable degree, on his surprize, at the command which
the man of wit has acquired over a part of the constitution,
which is so little subject to the will. Hence it is, that we
are more pleased with a bon mot which occurs in conversa-
tion than with one in print; and that we never fail to receive
diftiff from wit, when we suspeet it to be premeditated.
The pleasure, too, which we receive from wit, is heightened,
when the original idea is started by one person, and the
related idea by another. Accordingly Dr. Campbell has
remarked, that a witty repartee is infinitely more pleasing
than a witty attack; and that an allusion will appear excel-
 lent when thrown out extemporary in conversation, which
would be deemed execrable in print.

To the same purpose another ingenious writer has ob-
served upon Mr. Locke's description of wit, that every
resemblance of ideas is not that which we call wit, unless
it be such an one that gives delight and surprize. These two
properties, he says, seem essential to wit, more particularly
the latter of them. In order, therefore, that the resem-
bance in the ideas be wit, it is necessary they should not lie
too near one another in the nature of things; for where the
likeness is obvious, it gives no surprize. Spectator, vol. i.
No. 62.

From this account of the nature of wit, it is easy to per-
ceive what good reason Cicero had for saying (De Orat.
lib. ii. cap. 54.) *Wit is a thing not to be learned; it is the off-
spring of nature, and proper effect of a bright and lively
fancy.* Cicero reduces wit to two kinds, viz. *cavillatio,
which, in our language, may be called continued wit, or
humour, and *dicatio, which may be termed concise wit, or jelling.*

The ingenious professor above cited fuggels the following
difference between invention and wit. The former depends, in most instances, on a com-
bination of those ideas which are connected by the lefs ob-
vious principles of association; and it may be called forth in
almost any mind by the preffure of external circumstancies.
The ideas which must be combined in order to produce the
latter are chiefly such as are associated by those flighter con-
nections which take place when the mind is careless and dif-
engaged. “If you have real wit,” says lord Cheltenfield,
“it willBow spontaneously, and you need not aim at it; for
in that cafe, the rule of the gopelf is reverfed; and it will
prove, Seek and you shall not find.” Accordingly wit is
promoted by a certain degree of intoxication, which pre-
vents the exercise of that attention which is necessary for in-
vention in matters of science.

For the nature of wit in general, the different kinds of
it, its use to an orator, and the manner in which it ought to
be conducted, see Ward's Orat. vol. ii. p. 195, &c.

Wit is also an appellation given to persons poifeded of
the faculty called *witt, effprit.*

A French author, who, in 1695, published a “Treatise
of Wit, du Bel Eprir,” lays down four characters of it.

1. A man, who, with an open air and easy motions,
 affecte those he converses with agreeably; and on any
 subject that presents itself, ‘advances new thoughts, and
 adorns them with a sprightly turn; is also the world over,
 a wit.

2. Another, who, efects solicitude about the choice and
delicacy of his sentiments, knows how to make himself valued
by I know not what elevation of discourse; who draws
much attention, and thaws great vivacity in his speaking, and
readines in his answers; is likewise acknowledged a wit.

3. A third, who takes lefs care about thinking than
about speaking well; who affects fine words, though
perhaps low and poor in matter; who pleases by an easy
pronunciation, and a certain tone of voice, is placed in the
same rank.

4. Another, whose chief aim is not to make himself
efteemed, so much as to raife mirth and laughter; who
jokes pertinently, rallies pleasantly, and finds something
to amuse himself in every petty subject; is likewise
allowed a wit.

Yet, it may be observed, that in all these cafes, there is
nothing of real wit, as above defined; but the whole is
imagination, or memory at mott: nay the whole is no more
than what temperament may give.

A true wit must have a just faculty of differenience; muft
have, at the fame time, both great energy, and peculiar
delicacy, in his sentiments; his imagination must be noble,
and at the fame time happy and agreeable; his expreffions
polite and well turned; without any thing of parade or
vainy in his discourse, or his carriage. It is not at all ef-
tential to a wit, to be ever hunting after the brilliant; still
studying fine thoughts, and affecting to fay nothing but
what may strike and surprize.

This is a fault very frequent in dramatic perfons; the
duke of Buckingham rallying it very justly.

“What is that thing which we flue wit do call?
’Tis when the wit of some great writer shall
So overflow, that is, be none at all,
That e’r his fools fpeak fene—.”

From the account we have given in the preceding article
of the difference between invention and wit, it appears, that
those who have the reputation of wits are commonly more
confident in their own powers, who allow the train of their
ideas to flow, in a great measure, its natural course, and
hazard in company every thing, good or bad, which occurs
to them. Men of modety and tafe feldom attempt wit in
a promiscuous fociety; or if they are forced to make fuch
an exertion, they are feldom fucceffful. Such men, however,
in the circle of their friends, to whom they can unbloom
themselves without revere, are frequently the moft amusing
and the moft intereting of companions; as the vivacity of
their wit is tempercd by a correct judgment and refined manners:
and as its effect is heightened by that fenfibillity and delicacy,
with which we fo rarely find it accompanied in the common
intercourse of life. When a man of wit makes an exertion
to dillinguifh himself, his fallies are commonly too far-fetched
to pleafe. He brings his mind into a ftate approaching that
of the inventor, and becomes rather ingenious than witty.

Genuine wit, says lord Cheltenfield, never made any man
laugh since the creation of the world: upon which profes-
for
for Stewart remarks, that this observation is just, if by genuine wit we mean wit wholly divested of every mixture of humour; and if by laughter we mean that convulsive and noisy agitation which is excited by the ludicrous. But there is unquestionably a smile appropriated to the flashes of wit; — a smile of surprize and wonder: — not altogether unlike the effect produced on the mind and the countenance by a feat of legerdemain when executed with uncommon excess.

**Humour, say our critics, is the genuine wit of comedy.**

**Witt-Fish, in Ichthyology, a name given by the Dutch in the East Indies to a fifth common on those coasts, and seeming to be of the tunia kind. It is of the size of our common whiting.** It has one single spine or prickle on its back, and has a long belly-fin reaching from the head to near the tail; its whole body is flaitred, and it has two long filaments or beards hanging from its snout, and is a very fine and delicate fish. Ray.

**Witt-Fish is also the name given by the Dutch to an East Indian fish, called by Mr. Ray, Albula Indica.**

**WITASARI, in Geography, a town of Sweden, in Vaalhall; 70 miles N. N. E. of Jamio.**

**WITCH of Endor, in Biblical History, a woman who had a familiar spirit, and who was employed by Saul to consult the deceased Samuel concerning the issue of his contest with the Philistines. See 1 Sam. xxviii.**

The explication of this part of facted history has greatly perplexed commentators and critics. Some, in deference to the authority of the ancient fathers of the Christian church, who ascribed to magicians and necromancers the power of calling up the souls of the dead, have given a literal interpretation of this history, and supposed that Samuel actually appeared to Saul. But to this opinion it has been justly objected, that it is repugnant to the order of the natural world, and to the doctrines of revelation respecting the state of the dead. It cannot be supposed consistent with a just reverence of God to believe, that he has subjected the souls of the departed, not excepting those of the most eminent saints and prophets, to be remanded back from their dignified abodes, by the practice of the most execrable rites, and at the call of some of the vilest mortals, and compelled to reveal what he has been fit to conceal. Natural reason confirms the suffrage of scripture, when it brands the whole magic art, to which evocations of the dead, and all necromantic divinations appertain, as founded in imposture. Others, who cannot admit that witches are able to disturb the souls of good men, much less of prophets, are nevertheless of opinion, that these wretched women can cause the devil to counterfeit the souls of the dead; and that in the case before us, an evil spirit appeared before Saul in the likeness of Samuel. (See Patrick in 1 Sam. xxviii. 12.) But this opinion gives an unwarrantable advantage for the support of idolatry to those impostures that were practised by heathen forcers and diviners. Besides, the very apparaition of a spiritual and incorporeal being, and the gift of prophecy, are real miracles, and cannot take place but by divine appointment: and lastly, the historian calls the appearance to Saul Samuel, which he could not do with truth, if it was no other than the devil, who here appears, not as a tempter, but as a very fervent reprover of impiety and wickedness.

Many learned men have, therefore, maintained, that it was neither Samuel, nor an evil spirit, who here appeared to Saul; but that the whole was the work of human imposture. In support of this opinion it may be pleaded, that the woman to whom Saul applied to call up Samuel was merely a ventriloquist, poising an art very serviceable to those who counterfeited the answers of the dead. This opinion, however, like the foregoing one, contradicts the sacred historian, who not only represents the Pytho-nes as affirming, but himself affirms, that the saw Samuel, and that Samuel spake to Saul: nor has he dropped the least hint that it was not the real Samuel of whom he was speaking.

Others have supposed, that the appearance of Samuel to Saul was a divine miracle: though whether the miracle consisted in raising Samuel, or in presenting an image or representation of him before Saul, it is not necessary to determine. Accordingly, the apparition must be ascribed, not to the power of enchantment, but to the immediate appo- pointment of God, as a rebuke and punishment to Saul. This opinion is maintained by Dr. Waterland, in his Sermons, vol. ii. p. 267, and defended by Dr. Delany in his Life of David; but combated by Dr. Chandler, with objections which, as far as they affect the scripture history of the matter, are answered or obviated by Mr. Farmer, in his Discourse on Miracles, p. 486, &c.

**WITCH-Hazle, in Botany. See Hazle.**

**WITCH Island, in Geography, one of the smaller Virgin islands; 6 miles E. of St. John.**

**WITCHCRAFT, the crime of forcery, especially in women.**

Many think there may be some foundation for what we call fascination and witchcraft. We have innumerable instances and histories to this purpose; which it would not be fair to set aside, merely because they are not reconcilable to our philosophy: but, as it happens, there seems to be something in philosophy to countenance some of them.

Indeed, the ridiculous stories that are generally told, and the many impurities and delusions that have been discovered, in all ages, are sufficient to demolish all faith in such a dubious crime; if the contrary evidence were not also extremely strong. Wherefore, (says judge Blackstone,) it seems to be the most eligible way to conclude, with an ingenious writer of our own (Spec. No. 167,) that in general there has been such a thing as witchcraft, though one cannot give credit to any particular modern instance of it. Some readers will, however, probably dissent from this inference of Mr. Addison, and the opinion of the learned judge, and incline to consider witchcraft in general as a species of imposture. See Magician, and Miracle.

What the writers in favour of the opinion advance, as their reasons, is as follows:

All living things, they say, emit effluvia, both by the breath and the pores of the skin. All bodies, therefore, within the sphere of their periphrasical or expiratory effluvia, will be affected by them; and that, in this or another manner, according to the quality of the fluid; and in this or that degree, according to the disposition of the emittent and recipient parts.

This, indeed, is incontestible; nor need we produce instances of animals exhaling sweet or stinking smells; or of infectious diseases conveyed by effluvia, &c. in confirmation of it.

Now, of all parts of an animal body, the eye, we know, is the quickset. It moves with the greatest celerity, and in all the variety of directions. Again, its coat and humours are permeable as any other part of the body (witness the rays of light it most copiously receives.) The eye, therefore, no doubt, emits its effluvia like the other parts. The fine humours of the eye must be continually exhaling. The heat of the pervading rays will rarely, and attenuate them: and that, with the subtle juice or spirit of the neighbouring
fund, the pray. The we large treatife (ling, the render and, large was the. It thus, is requiring crying full, admirable becaufe and, dog's a

and, extraordinary difpleafed, quantity wherefore witchcraft it been, been al of the branch called fascination. It is certain the eye has always been efteemed the chief feat, or rather organ, of witchcraft; though, by moft, without knowing why, or wherefore: the eftect was apparently owing to the eye; but how, was not dreamed of. Thus, the phrase, to have an evil eye, imports as much as to be a witch. And hence Virgil,

"Necio quis teneros oculus mihi fascinat agnos."

Again, old bilious perffons are thofe most frequently suppofed to have the faculty; the nervous juice in them being depraved and irritated by a vicous habitude of body, and so rendered more penetrating and malignant. And young perffons, chiefly children and girls, are most affected by it; becaufe their pores are patent, their juices incoherent, and their fibres delicate and susceptible. Accordingly the witchcraft mentioned by Virgil only reaches to the tender lambs.

Laftly, the faculty is only exercised when the perffon is difpleafed, provoked, irritated, &c. it requiring some extraordinary fires and emotion of mind to dart a proper quantity of the effluvia, with a sufficient impetus, to produce the eftect at a distance. That the eye has some very confiderable powers is palt difpute.

The ancient naturalists affure us, that the balilific and opoblepa kill other animals merely by flaring at them. If this fail of credit, a late author affures us to have seen a mouse running round a large fnafe, which fwood looking earneftly at it, with its mouth open; till the mouse made lefs and lefs circles about it; crying all the while, as if compelled to it; and, at laft, with much feeming reluctance, ran into the gaping mouth, and was immediately swallowed.

Who has not observed a setting-dog; and the eftects of its eye on the partridge? The poor bird, when once its eyes meet thofe of the dog, flands as if confounded, regardles of itself, and eafily lets the net be drawn over it. We remember to have read of fquirrels aloftupified and overcome by a dog's flaring hard at them, and thus made to drop out of the trees into his mouth.

That man is not fecure from the like affections is matter of eafy obfervation. Few people but have, again and again, felt the effects of an angry, a fierce, a commanding, a dif-
dainful, a lascivious, an intriguing eye, &c. These effects of the eye, at leaft, make a kind of witchcraft. But our readers will excuse our enlarging.

Witchcraft prevailed to fuch a degree both in England and Scotland in the 16th century, that it attracted the attention of government under the reign of Henry VIII., in whose 33d year was enacted a flatute which adjudged all witchcraft and forcer to be felony without benefit of clergy; and at the commencement of the reign of Elizabeth, the evil seems to have been very much on the increafe; for bishop Jewel, in a fermon preached before the queen in 1558, tells her; "It may pleaf the your grace to underland that witches and forcerers within these four laf years are marvellously increased within your grace's realm. Your grace's subjects pine away even unto the death, their colour faded, their flesh rotten, their speech bennimated, their fenfe are bereft; I pray God they never pratiſhe further than upon the subject." Of the prevalence of this deluſion in 1584, we have the testimony of Reginald Scot, in his treatife intituled "The Discoverie of Witchcraft," written in behalf of the poor, the aged, and the fimple, as the author informs us; and it reflects fignificant difcredit on the age in which it was produced, that a deluſion fo complete, both with regard to argument and fact, fhould have failed in effecting its purpofe. The milchif, inced of being refrained, was rapidly accelerated by the publication of the "Demonologie" of king James, at Edinburgh, in the year 1597; and the contagion was promoted by the fucceſion of James to the throne of Elizabeth. In the year 1603, the royal treatife was printed at London, with an alarming preface concerning the increafe of witches or enchanters, "these deteſtable flames of the devil," and it was accompanied by a new flatute againſt witches, which deſcribes the crime in a variety of particulars, and enacts, that offenders, duly and lawfully convicted and attainted, fhall suffer death. Reginald Scot, in his treatife above-mentioned, has pourtrayed at large the character of thofe who were branded with the appellation of witches, flating the deeds that were imputed to them, and the nature of their suppoſed compact with the devil. The abode of a witch is admirably defcribed by Spenfer, the description being formed from an existing ſubject:

"There in a gloomy hollow glen the found
A little cottage built of thicket and reedes
In homely wife, and wald with fods around;
In which a witch did dwell, in loathly weedes
And willful want, all carfules of her needes;
So chooſing solitarie to abide
Far from all neighbours, that her devilish deeds
And holliff arts from people the might hide,
And hurt far off unknowne whom ever the environ."

Faerie Queene.

Scot has, with singular induſtry, collected from every writer on the ſubject the minutiae of witchcraft, and he has annexed comments for the purpofe of refuting and exposing them; whereas James, the royal ſedant, wrote in defence of this folly, and, unfortunately for truth and humanity, the doctrine of the monarch was preferred to that of the fage.

The old laws made in England and Scotland againſt con juration and witchcraft are repealed by a late ſtatute, and no perfon is to be proceeded for any fuch crime. 9 Geo. II. c. 5. See Conjurati on.

WITCHES-BUTTER, a name given by the common people of England to a fort of tremella growing on the bark of old trees, in form of a corrugated membrane.

WITELSHOFEN, in Geography, a town of Germany,
many, in the margin rate of Anspach; 7 miles S.E. of Crediheim.

WITGENAU, or Withenau, a town of Lusatia, on the Elster; 13 miles N.N.W. of Bautzen. N. lat. 51° 20'. E. long. 14° 10'.

WITGENAU, or Wittenburg, or Těžebon, a town of Bohemia, in the circle of Bechin, on the river Lounficz; 22 miles S.S.E. of Bechin. N. lat. 49° 4'. E. long. 14° 40'.

WITGENSTEIN, a county of Germany, situated between the principalities of Heuff Darmstadt, Nassau Dillenburg, and the duchy of Welfphalia; about 18 miles long, and 12 broad. Some parts are mountainous and woody, and contain mines of silver, copper, and iron; the pastures are good, but the arable land inconvenient. The principal rivers are the Lahn and the Eder. It is united to the county of Sayn, and that princely house is divided into two branches, Sayn Witgenstein of Witgenstein, and Sayn Witgenstein of Berleburg, each of which had a distinct vote in the Imperial college, and in the diet of the Upper Rhen. The county takes its name from a feat, the residence of the counts, which is situated on a mountain; 1 mile N. of Laafhe.

WITGEWALT, a town of Prufia, in Oberland; 8 miles N.E. of Oletterode.

WITH-VINE, or Wine, in Agriculture, a term provincially signifying couched, or couched-gras. See Bind-Wheat.

WITHAM, in Geography, a market-town and parish in the hundred of the same name, in the county of Essex, England, situated on a branch of the river Blackwater, 83 miles N.E. from Chelmsford, and 37½ in the same direction from London. By the parliamentary returns of 1811, the number of houses in the parish was 466, and the inhabitants amounted to 2352. Witham has a weekly market on Tuesday, and fairs on Friday and Saturday of Whits-week, on the 14th of September, and 5th of November. The petty feittions for the Witham division of the county are also held in the town. Witham is supposed to have been constituted a town by Edward the Elder, though perhaps it was only reformed by him, at least the part on Cheping Hill round the church, which stands about a half a mile N.W. from the other part of the town. On this eminence are considerable remains of a circular camp, inclosed by a double ditch and rampart. From this work, and the quantity of Roman bricks worked up in the body and tower of the church, Witham has been thought to occupy the position of the Canomium of Antoninus. The manor was anciently possesed by earl Harold, and afterwards by Eulace, earl of Boulogne, who married the sister of Edward the Confessor. Near the end of the town is a manor, now possesed by Thomas Kynalton, esq., but formerly belonging to the late earl of Abercorn. Faukbourne-hall, between one and two miles N.W. from Witham church, is the seat of colonel Bullock, formerly member of parliament for the county of Essex. Here is a cedar-tree, about nineteen feet in circumference near the ground. A coin of Domitian and velliges of walls indicate the Romans to have had a villa at this place.—Beauties of England and Wales, Essex. By J. Britton and E.W. Brayley. 8vo. 1808.

WITHAM, a river of England, in the county of Lincoln, which rises in the fourth part of Lincolnshire, on the borders of Leicestershire, palies by Grantham to Lincoln, where it becomes navigable; from thence it palies by Tattersall, Bolton, &c. and runs into the German sea, 5 miles below Bolton, in what are called the Washes.

WITHAL, in Agriculture, a small twelved flick of any kind used as a band.

WITHER-BAND, in Rural Economy, the band or piece of iron which is laid underneath a saddle, about four fingers above the withers of the horse, to keep tight the two pieces of wood that form the bow of the saddle.

WITHER-WRANG, in the Meische. A horse is said to be wither-wrang, when it has got a hurt in the withers; which fort of hurts it is very hard to cure. See WITHERS.

WITHERING, William, M.D. F.R.S., in Biography, was born in 1741, and finished his medical education in the university of Edinburgh, where he took his degree of doctor in 1766. From Stafford, where he first settled and married, he removed to Birmingham, and speedily attained by his skill and affiduity to very extensive and profitable practice; without seeking much society or neglecting his scientific pursuits in order to secure it. The chief objects of his attention, independently of his professional engagements, were botany and chemistry. The result of his scientific inquiries and labours appears in the following list of his valuable publications; viz. “A Botanical Arrangement of British Plants,” in 2 vols. 8vo. 1776, which passed through two more editions, in 1787, 3 vols., and in 1796, 4 vols., with numerous improvements and additions, some of which were suggested by his friends, and particularly by Dr. Stokes. In chemistry and mineralogy, a translation of Bergman’s “Sciagraphia Regni Mineralis,” 1783, and the following papers in the Philosophical Transactions; “Experiments on different Kinds of Marle found in Staffordshire,” 1773; “An Analysis of the Toad-flame of Derbyshire,” 1782; “Experiments on the Terra Ponderosa,” 1784; and “An Analysis of a Hot Mineral Spring in Portugal,” 1798. In the improvement of his own profession, “Account of the Scarlet Fever and Sore Throat, particularly as it appeared at Birmingham in the year 1778;” and “An Account of the Fox-glove and some of its Medical Ufes; with Practical Remarks on the Dropy and other Difeases,” 1785. Subject to pulmonary attacks, which weakened his lungs, he thought it necessary, in 1793 and 1794, to pass the winter in a warmer climate, and he fixed on Lisbon. Afterwards he became incapable of his former professional exertions, and died at the Larches, near Birmingham, in November 1799, at the age of 58. In his intellectual character he joined unremitted application with sagacity and diligence. In his medical practice he limited prescription to that quantity and kind of medicine which was absolutely necessary for his patients; and if any in the inferior branches of the profession disliked this mode of practice, their disapprobation of it was a testimony in its favour. In his disposition he was mild and humane; and his natural reserve did not preclude him from the pleasures of rational society. His valuable library and handsome property were inherited by an only son.


WITHERING, in Medicine. See ARIDURA.

WITHERING of a Cow, is when, after calving, she does not call her cleaning, which, if not timely remedied, will kill her.

WITHERINGIA, in Botany, was so named by the great French botanist, M. L’Heritier, (see that article,) in compliment to the late Dr. William Withering, F.R.S. F.L.S., the well-known author of a most useful and popular English work, entitled an “Arrangement of British Plants,” which has gone through several editions, in some of the earlier of which Dr. Stokes was his coadjutor. (See STOKESIA.)—L’Herit. Sert. Angl. 33. Schreb. Gen. 791. Wild. Sp.
It occurs in considerable quantities on the western side of Yorkshire, and in the counties of Northumberland, Durham, and Westmorland, in veins which traverse mountain lime-flone and sand-flone. In some of these veins it has been observed, that when the vein passes through the lime-flone, it contains Witherite, or carbonate of barytes; but where it passes through the sand-flone, it contains sulphate of barytes, or heavy spar. It sometimes occurs in a flàSalatic or cellular form, and disseminated in other minerals.

Witherite is rather a scarce mineral on the continent. It is a very active poisons. It has not been used in the arts in this country. It is probable that it may be employed on the continent in the composition of the alkaline fulphates, as foreigners sometimes obtain it from the mines in Yorkshire in considerable quantities.

WITHERNAM, in Law, a repriph, or taking of other goods or cattle, in lieu of those unjustly taken and effoned, or otherwise withheld.

The word is compounded of the Saxon wither, contra, again; and nam, captio, taking. See NAAM.

Where goods are taken by colour of divers, and driven to a hold, or out of the county, so that the sheriff cannot, upon replevy, make deliverance thereof to the party dis-tributed; in this case, the writ of captas in withernam, or de vesito namo, is issued, directed to the sheriff, for the taking as many of the party's beasts, as he did thus unlawfully dis-tribute; or as much goods of his, till he has made deliverance of the first divers; and, therefore, goods taken in withernam cannot be reprieved, till the original divers is forthcoming.

WITHERNAM. Homine captio in. See HOMINE.

WITHERS of a Horse, the juncture of the shoulderbones at the bottom of the neck and man, towards the upper part of the shouder.

These parts should be well raised and pretty strong, for this is a figure of strength and goodnes in the horfe. They keep the faddle from coming forward upon the horfe's shoulders and neck, which immediately galls and spoils him. A hurt in this part is very difficult to cure, and, for this reason, they should be lean rather than fliehy, as they are then less subject to be bruised and hurt by the faddle.

When there are fores on the withers, the caufe muft be looked to, in order to determine a proper cure, and prevent a return. If the hurt be caufed by the larngefles of the faddle-bands, provided that it be not too great, it may be easily cured by the following remedy: take the whites of fix eggs, beat them with a piece of alun as big as an egg for a quarter of an hour, or till the whole is reduced to a thick leum or froth; let the swelling be rubbed well with this mixture, and then covered over with more of the froth; this is to be left to dry on, and the application is to be repeated every ten or twelve hours; notwithstanding that the heat and swelling remains, this, by degrees, will take place, though not at firft.

If the hurt be great, recourfe muft be had to bleeding; and this may be repeated after two days, if the swelling and inflammation continue.

If a tumour, with great inflammation, follow a bruife with the faddle-bows, the part affected is to be rubbed with lime-water, and covered with a lamb's skin, the woolly part next the back; after the washing, the ointment, well known among our farriers by the name of the duke's ointment, is to be applied; and if the tumour inclines to suppurate, the ointment must be washed off with a mixture of vinegar and water, warmed, mixed with a handful of falt to every quart of it; an ointment is then to be made of half a pound of populace, and a quarter of a pound of black soap, and as much
much honey: these are to be thinned with a large glafs of
spirit of wine, and the part is to be well rubbed with some
of this three or four times a-day, covering it afterwards
with a lamb's skin. Some ufe instead of this ointment a
poultice made of powder of cummin-feed, linseed-oil, and
pigeons' dung, which does as well.
Where these means are not fufficient to remove such
ulcers or fwellings, a more effectual remedy may frequently
be found in the blitting liniment.
But wherever matter is formed and distinctly felt by the
finger, an opening fou ld be made as near as possible to the
mouth depending part of it, to allow of a free discharge of
it, and a rowel be introduced through the whole extent of
the cavity, and be frequently moved, and washed with spi-
rits of turpentine; the healing proefs being promoted by
the injection of stimulating wafhes.
In cafes where sinus-es are formed, and thofe means are in-
fufficient for healing the parts, the cure much be performed
by making an incision through the whole extent of the
hollow parts; dressing them afterwards in fuch a manner as
to keep down the proud flesh, and preferring the wounds
clean, as well as aiding the growth of new flesh by proper
means. See Ulcer, and Wound, in Animals.
Withers of the Bow of a Saddle, in the Manage. See
Bow.
WITY, a large species of willow, fit to be planted
upon high banks and fides of ditches, within reach of the
water, or on the weeping fides of hills.
Withy-Cragged, a term fometimes applied to a disease
in horses. See Strain.
WITLAGE, in Geography, a town of Welfphalia, in
the biphoric of Ofnabruck; 11 miles E.N.E. of Vorden.
WITLAH, a town of Germany, in the county of Ven-
der; 3 miles S.E. of Vorden.
WITLOWZ, a town of Bohemia, in the circle of
Konalingratz; 16 miles N.N.E. of Gittichen.
WITMARSEN, a town of Germany, in the biphoric of
Munfer; 7 miles W. of Lingen.
WITNESS, Testis, a person who certifies or afferts
the truth of any fact.
All witnefses are deemed competent, who, having the ufe
of their reafon, are neither infamous nor intereffed in the
event. See Evidence.
Among the Romans, it was a cuftom to pull or pinch
the ears of witnefses prefent at any tran fantion; that they
might remember it when they were called to give in their
testimony. Two eye-witnefses, or de viju, not fufpefted,
are to be deemed a conclusive proof.
Falsc witnefses, suborners of witnefses, &c. in England
are punifhed with the pillory; in feveral other countries,
with death. See Perjury, Subornation, &c.
In a synod at Rome, under Conftantine, in the year 320,
it was decreed, that there should be feventy-two witnefses
heard, to condemn a bifhop; which was called libra tefium,
a poad of witnefses. Accordingly there were feventy-two
witnefses heard againft pope Marcellinus; who, says the his-
torian, erat eftus libri occidua.
Anciently there were synodal witnefses, tesfes synodales, in
each parish, chofen by the bifhop, to inquire into the her-
eties, and other crimes, of the parishioners; and to make
oath thereof on the relics of the saints. See Synodales.
Witness, Attic. See Attic.
Witnefses, Trial by, in Law, is a species of trial, with-
out the intervention of a jury. This is the only method of
trial known to the civil law; in which the judge is left to
form in his own breath his fentence upon the credit of the
witnefses examined; but it is very rarely ufed in our law,
except only that when a widow brings a writ of dower, and
the tenant pleads that the husband is not dead; this is, in
favour of the widow and for greater expedition, allowed to
be tried by witnefses examined before the judges; and alfo
in fome other cafes mentioned by Sir Edward Coke, as to
try whether the tenant in a real aotion was duly summoned,
or the validity of a challenge to a juror: who observes, that
in every cafe the affirmative must be proved by two witnefses
at the leat. Blackf#. Com. book iii.
WITNEY, in Geography, in the hundred of Bampton,
and county of Oxford, England, is a long and irregular,
but large and populous market-town, situated 11 miles
W.N.W. from Oxford, and nearly 66 in the fame direction
from London. Through the town runs the little river
Windrush. Witney was one of the eight mansons given to
his cathedral in 1040 by Alwin, bishop of Winchefter, in
confequence of the fulpicion of his improper conduct with
Emma, the mother of Edward the Confefsor. The queen-
mother cleared herfelf by the fiery ordeal (an experiment of
probably little danger), and the bifhop made reparation for
the scandal he had, although innocent, brought upon his
church by a transfer to the clergy belonging to it of eight
of his manors. In 1171 the manor was, by bishop Blot,
befought on his new foundation of St. Crofs, near Winche-
fter. In the fifth year of Edward II. Witney became a
borough, and continued to fend members to parliament till the
33rd year of Edward III. when the privilege was declined:
it is still, however, called a borough, and governed by two
bailliffs. The church, terminating the principal freet, is large
and handsome, with crofs aifles, furmounted by a tower and
spire. A free-school was founded here in 1660, and other
charitable institutions for the education of youth have lately
been formed. Witney has long been celebrated for the ma-
ufacture of blankets, of which the weavers were incorpo-
rated in queen Anne's reign. When Dr. Plott pubhished
his Natural History of Oxfordshire, in 1677, the weaving
buifenes employed no fewer than 5000 perfons, "from chil-
dren of eight years old, to decrepit old age," a number pro-
bably not exaggarated, if it be confidered, that, in his time,
every part of the manufacture was performed by manual
labour. But in the latter half of the latt century the 
blanket trade fuffered a great defacation. In 1768 about
500 weavers only were employed, a number which gra-
dually funk to lefs than one half; the confequence of which
was great diftrefs among the inhabitants. Machinery was
introduced into the manufacture, by which one man per-
formed the work of two. The blanket buifenes again re-
vived; but the working hands reaped no benefit from its
revival. In 1807, when the price of blankets was five
pounds the pair, the workmen earned but twelve fhillings
per week, the fame sum as in 1768, when the pair brought
only three pounds. The flape, or blanket-hall, fands in the
high freet, as does alfo the town-hall, under which is a
place for the market. The rectory of the parish is united
with the vicarage, and in the patronage of the bifhop of
Winchefter. The town contains meeting-houfes for dif-
dferent defcriptions of diflenters. According to the popu-
lation return of 1811, the houfes in the town were 542,
and the inhabitants 2722.—Plott's Natural History of
Oxfordshire, 1677 and 1705; fol. Beaulies of England,
Oxfordshire, by J. N. Brewer, 8vo. 1813.
WITRY, a town of France, in the department of the
Marne; 6 miles N.E. of Rims.
WITSENIA, in Botany, was fo named by professor
Thunberg, in compliment to Mr. Witven, "Councilor to
the Chief Magiftrate of Amsterdam," whom he styles a moft
eminent patron and promotor of every kind of fience.
Profeflor

Gen. Ch. Call. none, unless the upper pair of the bracteas be so considered. Cor. of one petal, tubular, erect: tube cylindrical, slender at the base, gradually dilated at the top: limb spreading, regular, in six fix, equal, obvolute segments. Stam. Filaments three, very short, inserted into the mouth of the tube, at the base of three alternate segments of the limb; anthers oblong, erect. Pf.l. German superior, roundish, small: style thread-shaped, erect, longer than the tube of the corolla, slightly curved at the extremity; stigma in three short, equal, rather spreading segments. Peric. Capsule membranous, of three cells and three valves. Seeds several, angular.


1. W. mauro. Downy-flowered Witfienia. Thunb. Nov. Gen. 34. t. 2. f. 1. Fl. Cap. v. 1. 255. Willd. n. 1. Vahl n. 1. Ait. n. 1. Redout. Liliac. t. 245. (Anthophyza mauro; Linn. Mant. 175.) —Flowers terminal, in pairs. Outer segments of the corolla externally downy. Native of the sandy sides of hills, at the Cape of Good Hope, flowering in April and May. Sent to Kew by Mr. Maffon, in 1795, but it does not appear to have bloomed in that collection, nor elsewhere in Europe. M. Redouté's fine figure being made from a dried specimen, aided by description. The root is perennial and woody. Stem shrubby, erect, more or less branched, two feet high, compressed; naked in the lower part, and appearing as if jointed, from the scars left by former foliage; leafy above. Leaves numerous, alternate, sessile, two-ranked, equitant, four or five inches long, compressed, falcate, acute, entire. Flowers in pairs at the extremities of the short terminal branches, crowded, more or less numerous, into a corymbose tuft. Corolla two inches long: its tube yellow at the base, dark blue for a considerable extent in the upper part; limb yellow, feecially spreading, half an inch long, clothed externally with dense yellow pubescence of a very peculiar kind, confined to the tips of the inner segments.

2. W. corymbofa. Corymbose Witfienia. Ker in Curt. Mag. t. 895. Ait. n. 2. Sm. Exot. Bot. v. 2. 177. n. 68. —Corymbose many-flowered. Corolla externally smooth. Native of the Cape of Good Hope. Raised from seed by G. Hibbert, eq?, in 1803. A green-house plant, flowering in spring and autumn. The flower is shrubby, from four to six inches high. Leaves like the leaf, but only half the fize, somewhat glaucous. Flowers very numerous, bright blue, in a forked corymbose, compound panicule, supported by a long stalk, at first terminal, but soon becoming lateral. Bracteas two pair at the base of each flower, concave, obtuse. Corolla about an inch long, including its horizontal limb.

3. W. ramoza. Branching Witfienia. Thunb. Fl. Cap. v. 1. 256. Vahl n. 2. (W. fruticosa; Ker in Ann. of Bot. v. 1. 237. Ixias fruticosa; Thunb. Diff. n. f. t. 1. f. 3. Lamarck Illust. t. 31. f. 4. Linn. Syst. 93.) —Stem much branched. Corolla externally smooth; its tube capillary, twice the length of the limb.—Native of hills at the Cape of Good Hope, flowering in October, November, and December. The flower is a fiam high at most, remarkably woody, repeatedly branched in a corymbose manner; naked below; the branches compressed, two-edged, knotty or scarred, as if jointed, leafy at their extremities. Leaves equitant, two-ranked, linear, narrow, one and a half or two inches long, rather glaucous; reddish at the base. Flowers terminal, very few together, if not quite solitary, blue, remarkable for the length and flenderness of their tube, which sometimes measures nearly two inches; the limb is rather less spreading, and more bell-shaped, than that of corymbofa. Bracteas membranous, elongated, brownish.

4. W. pumila. Dwarf Witfienia. Vahl n. 3. (Ixyia pumila; Forth. Comm. Gott. v. 9. n. 20. t. 2. I. magnelliana; Lamarck Illustr. v. 1. 109. Morea magellana; Willd. Sp. Pl. v. 1. 241, excluding Cavanilles' Ixolium. Tappein. Jull. 59.)—Stems simple, single-flowered.—Gathered by Forfier, Commeron, and others, at the fraxins of Magellan. The root is perennial, long, branched, bearing dense tufts of numerous, simple, leafy Ixias, an inch or half a inch high. Leaves crowded, two-ranked, awl-shaped, compressed, strongly ribbed, about an inch long. Flowers whitish, small, solitary, nearly sessile, among the uppermost leaves, which form a kind of sheath, but each appears to have also a bivalve sheath, or pair of bracteas, which are permanent. Capsule brown, with rather rigid, emarginate valves.

Mr. Ker observes, that this is the only genus of its natural order whose habit is in any degree shrubby. He mentions, in the Annals of Botany, another species, by the name of partita, seen by himself in Mr. Hibbert's herbarium; but without any indication of its characters, so that we have no means of knowing how it differs from the foregoing.

WITTSIO, in Geography, a town of Sweden, in the province of Schonen; 28 miles N.N.W. of Christianstadt.

WITT, John de, in Biography, the son of a burgomeister of Dordrecht, was born in 1625, and educated in various useful sciences, so as to excel in a knowledge of jurisprudence, politics, and mathematics, in the latter of which he was so great a proficient, that he wrote a treatise on the elements of curve-lines, which was published under the inspection of Francis Schooten. For further improvement he spent some years in travel, and upon his return was elected to his father's post of peninsory of Dordrecht. Attached by his descent to the principles of republican, and jealous of the house of Orange, he opposed the elevation of this house, and diffused the province of Zealand from conferring the office of captain-general upon the young prince, William III. His conduct in this business was much approved, and he was henceforth regarded as at the head of the political administration of the United Provinces. This was a period peculiarly critical and interesting: The war with the new English republic distressed the states; it was injurious to their trade and finances; and preferred to the Orange party a favourable opportunity for advancing prince William to the power and dignities possessed by his ancestors. Peace at length became absolutely necessary; and one of the articles concluded upon in 1654, and dictated by Cromwell, was the perpetual exclusion of the prince of Orange from the high offices formerly held by his family. This article was agreed to by his states of Holland alone, and when de Witt drew up a declaration for divulging
WIT

it, some of the provinces cenured it, and charged the anti-
Orange party with having fuggled it to Cromwell. The
province of Holland, however, carried the point, and the ge-
neral tranquility was little disturbed. De Witt now directed
his attention to the flate of the finances, and succeeded in
reducing the interest of the public debt, and perfuading the
people to acquiefce in this meafeure. The retoration of
Charles II. was generally agreeable to the United States,
and more especially to the Orange party: but the refored
sovereign foon declared his difaffection with De Witt, be-
cause he had been hostile to the elevation of the House
of Orange. From this time, the Dutch flatesman favoured
the politics of France more than those of England. At length
a war took place between the Dutch and English in 1665;
during the progress of which De Witt was often unpopular,
though he was the main spring which kept in action the
resources of the flate, and remedied every calamity. Peace
with England in 1667 developed the ambitious projects
of Lewis XIV. in taking poiffion of the Spanish Netherlands;
and the alarm which this meafeure produced in the United Pro-
vinces gave occasion to the friends of the house of Orange
to propofe the elevation of the young prince to the dignities
which his family had poiffefed. De Witt, with a view of
counteracting this purpose, obtained a resolution on the part
of the flates of Holland for separating the offices of captain-
general and fladholder (see William III.), which resolution
gave great offenfe to the other provinces, and rendered
De Witt, with whom it was fuppofed to have originated,
exremely unpopular. Senfible, however, of the dangers
arifing from French ambition, he concurred in the triple
alliance between England, Sweden, and the United Provinces,
concluded, in 1668, by himself and Sir William Temple.
The flates of Holland were fo satisfied with his conduct, that
they nominated him for five years more to the office of their
penionary, which he had already occupied for fifteen years.
Confiding in the triple alliance, and the fubsequent peace of
Aix-la-Chapelle, he again indulged his jealoufy of the Orange
party and a flanding army, and confidered the danger from
France as a secondary object. But the ambition of Lewis
had no bounds; the unprincipled Charles II. could not be
relifed upon; the triple alliance was fet aside; and the Eng-
lish cabinet joined the French in direct war with the United
Provinces; fo that in the year 1672 a French army made an
irruption into the territories of the flates, and threatened to
overwhelm the whole country. The anti-Orangeflits were
then compelld to confer the chief command on William.
The conduct of the French had been fo atrocious, that every
perfon who had manifefled the lighteft attachment to their
politics was charged with treason. De Witt became the ob-
ject of public indignation, and to him were ascribed all the
calamities which were felt or feared. Four affajins attempted
his life, as he was returning home from an afsembly of the
flates of Holland, attended by a single fervant; but though
he received many wounds, none of them were mortal. One
of the affajins was taken and executed; but such is the in-
fluence of party, the friends of the house of Orange regarded
the wretch as a martyr. Cornelius de Witt, on his return
from the fleet, where he had served as deputy of the flates,
narrowly escaped from a fimilar attempt. The prince was
now elevated to the fladholderate; and the penionary, as
soon as he was recovered from his wounds, visited him with
congratulation on the event, but was cooly received.
Finding that, as he was become an object of the public
hatred, he could be no longer of any fervice, he requested
permitfion from the flates of Holland to reign in his office,
which was granted him upon the moft honourable terms.
His brother was at this time imprifoned among common
felons at the Hague, under a charge, preferred by a perfon
of infamous character, of having formed a plot againft the
life of the prince of Orange. On his trial he was put to
the torture, in the moft cruel form of applying it; but
though he endured the moft aggravated fufferings, profting
his innocence, and citing his judges before the tribunal of
God for their treatment of him, they pronounced sentence,
which deprived him of all his dignities, and banifhed him
for life from the province. Although no criminal charge
was brought againft John de Witt, the enemies of the fa-
mily resolved that neither of the brothers should efcape with
life. Decoyed by a feticious meafeure to visit his brother
Cornelius in the prifon, a furious mob assembled to prevent
his return. The flates of Holland ordered a guard to dif-
perfe the people, and requelted some companies of horfe and
foot to be fent from the camp of the prince of Orange.
But the commanding officers were inveterate in their enmity
againft the De Witts; and the inflamed populace, not re-
frained from executing their bloody purpofe, forced open
the doors of the prifon, dragged out the two brothers, and
inhumanly malacled them. This catastrophe took place in
August 1672, John de Witt being in the 47th year of his age.
Although the flates of Holland pronounced the deed to be
detellable, and requelted the fladholder to take proper mea-
ures for avenging the death of these two brothers, it was
pretended that it would be dangerous to inquire into a
deed in which the principal burghers of the Hague were con-
cerned, and therefore none of the murderers were brought
to justice. It should, however, be recollected, that the
prince never spoke of this malacre without the greateft
horror.

The character of De Witt has been defcribed in honour-
able terms by Sir William Temple, who knew him well,
both in private life and in his public station. He speaks of
him as a perfon of indefatigable application, of invincible
resolution, of a found and clear judgment, and of irre-
proachable integrity, infomuch, that if he was blinded in
any refept, it was in confequence of his passion for pro-
moting what he thought the welfare of his country. He
bears testimony to the penionary's knowledge of the interets
of foreign courts, though he did not make fufficient allow-
ance for the treachery of princes, or rather their mimifers,
and was thus mifled with regard to the ambitious views of
France. If he had any wrong bias in his political conduct,
it was that of an hereditary jealoufy and dislike of the house
of Orange, which led him in some cafes to act rather as a
party leader than an unprejudiced patriot. No man could
be lefs influenced than De Witt by views of avarice or ollen-
tation. His manners and appearance were adapted to the
ancient simplicity and frugality of his country, even in the
height of his power. When his papers and private letters
were submitted to a rigorous scrutiny after his death, nothing
was discovered that could impeach his integrity. When one
of the commiffioners was asked what they had found in De
Witt's papers; "What (fay I) could we have found—
nothing but probity?" As a man of business, he was fcru-
pulously attentive to order and method; and when he was
once afked, How he was able to transact fuch a multiplicity
of affairs? he replied, "By doing only one thing at a time."


WITT, in Geography, a river of Germany, which rises near Hackenburg Sayn, and after a circuitous
course runs into the Rhine, about a mile below Neuwied.

WITTEL, a small town in Steinhude lake, with a
fort; 3 miles N. of Hagenburg.

WITTELHE, a town of Germany, in the county of
Verden; 10 miles S.E. of Verden.

Vol. XXXVIII.
WITTEM, a citadel of France, in the department of the Reor. It heretofore gave name to a lordship, wholly surrounded by the duchy of Limburg; 6 miles S. E. of Aix-la-Chapelle. 

WITTEN, in Commerce, a money of account at Pernau and Stettin, &c. At Pernau a current rix-dollar is reckoned at 60 wittens, or 75 copecks; and an Albert's rix-dollar is estimated at 80 wittens, or 100 copecks; a Pernau mark is worth 3 wittens; a Lethvit mark = 2 wittens; and 4 wittens = 5 copecks. At Stettin the rix-dollar was formerly divided into 36 shillings current, 72 shillings Sundish, or 144 wittens; which monies of account are now nearly discontinued. 

Witten, in Geography, a town of Germany, in the county of Mark; 7 miles S. E. of Bockum. 

WITTEN-GEMOTE, among our Saxon Aecelors, a term literally signifying a council, or assembly of fages, or wife men; applied to the great council of the land, in later days called parliament; which fee. See also Gemote. 

In the Saxon times, this was the chief court of the kingdom, where all matters, both civil and criminal, and those relating to the revenue, were determined. In civil and criminal matters, it was a court, in the first instance only, for facts arising in the county where it sat; but it heard and determined causes from all other counties by way of appeal. To this court were summoned the earls of each county, and the lords of each fee, as also the representatives of towns, who were chosen by their burghers. This was the legislative and supreme judicial assembly of the Anglo-Saxon nation. As highest judicial court of the kingdom, it resembled our present house of lords; and in those periods, when the peers of the realm represented territorial property rather than hereditary dignities, the comparison between the Saxon witten-gemote, and the upper house of our modern parliament, might have been more correctly made in their legislative capacity. The German states are recorded by Tacitus to have had national councils, and the continental Saxons are also said to have possessed them. When the Cyning was only the temporary commander of the nation for the purposes of war, whose function ceased when peace returned, the witten-gemote must have been the supreme authority of the nation; but when the Cyning became an established and permanent dignity, whose privileges and power were perpetually increasing till he attained the majesty prerogatives and widely-diffused property which Athelstan and Edgar enjoyed, the witten-gemote then assumed a secondary rank in the state. This council was called by different names, and it was composed of persons who were denominated witan from their presumed wisdom, and with reference to their rank and property, cdeo, (the wealthy), optimates, principes, primates, proceres, cucionatores anglicæ, &c. The gemotes of the witan, without doubt, varied, as our parliaments vary, in the number and quality of the persons who from time to time attended. Most of whose names are subcribed to councils or charters, and who appear to have been the witan who constituted the gemote, have some titles after their names; but there are some gemotes which have names without any addition. It is not easy to ascertain all the qualifications which entitled persons to a seat in the witten-gemote. There is, however, one curious passage, cited from the Book of Ely, in Gale's Script. vol. i. p. 513, which has been alleged by some writers as ascertaining that a certain amount of property was an indispenfable requisite, and that acquired property would answer this purpose as well as hereditary property. The possession stated to be necessary to constitute one of the procures was forty hides of land. The incident to which this passage refers occurred in the reign of Edward the Confessor. It related to the brother of an abbot, who, though nobly born, could not be reckoned among the nobility of the kingdom, because he had not an eftate of forty hides of land; and therefore, he was refused by a lady, whom he fought in marriage, till his eftate was increased to that magnitude by grants of land from his brother. This passage merely proves, that a certain portion, and that a very large one, of landed property in domicilio was a necessary qualification, under the Anglo-Saxon government, to admit any person to the "rank and degree of nobility." But no argument, says lord Littellon, can be justly drawn from hence, that, in order to be qualified for a place in the Saxon great council, or witten-gemote, it was requisite to be lord of forty hides of land. Such a notion does not agree with any accounts that are given us of that assembly in the writings or records of those times. By a passage in the preface to Ina's laws, as translated by Wilkins, it appears, that the Saxon legislature was composed of the king, cum omnibus suis senatores, which senators Littellon supposes to have been the "nobility of the kingdom," such as afterwards formed the ordinary council of lords under our kings of Norman race; cum senisioribus fanctis, by whom he understands the deputies or representatives of the people, either by election or magistracy; cum multis etiam feiicatae minifterorum Dii, which words evidently denote the inferior clergy, mentioned by Eadmer as present in the parliaments of those times. It appears also, by a paragraph in Spelman's Councils Sub. Ann. 855, that the Saxon constitution required not only the "presence," (see Borough, but the "approval of the people," to the enacting of a law; though, by way of marking the distinction between the and the higher orders of the state, the nobility alone set their hands to the act. "Whoever," sairs John Forseue Aland, who was very learned in the Saxon language and legal antiquities, in his preface to the book of chancellor Forseue on the difference between an absolute and limited monarchy, "carefully and skilfully reads the Saxon laws, and the precedes or preambles to them, will find, that the commons of England always in the Saxon times made part of that august assembly." In a passage occurring in lib. iii. f. 56 of William of Malmsbury, we have an express declaration, that by the Saxon constitution established in England, the "people," as well as the nobles, had a right to be called to the "General Assembly" upon affairs of great moment, and to join in the "edicta" made there; so that, without, "their consent," the succession to the crown could not be settled. The term Senatus used by this historian denotes the ordinary assembly of the nobles, which he distinguishes from the "people;" but he supposes that the latter ought to be joined to the former, in order to compose the entire legislature and great council of the nation, upon extraordinary occasions. This was agreeable to the custom ascribed by Tacitus to the Germans, from whom they sprung; "De minoribus rebus principes consultans, de majoribus omnes; ita tamen, ut ea quoque, quorum apud plebem arbitrium est, apud principes præfentantur." See Borough. 

It has been, among constitutional antiques, an interesting question, whether they who possessed this quantity of land had thereby the right of being in the witten-gemote; or whether the members of this great council were elected from the territorial proprietors, and fat as their representatives? One person is mentioned by Mr. Turner (ubi infra), whose
whose designation seems to have the force of expressing an elected member. Among the persons signifying to the act of the gemote at Clofesnwe in 824 is, "Ego Beonna electus consent. et suberfii.'

The members of the gemote were convened by the king's writ, of which many instances occur; and the times of their meeting seem to have been usually the great festivals of the church, as Christmas, Easter, and Whitfuntide; but of these Easter, being most frequently mentioned, seem to have been the favourite period. Their meetings, however, were not absolutely restricted to these seasons. The place of their assembly was not fixed. Perhaps this might depend on the king's residence at the time, and might have suited his convenience. Our monarchs seem to have maintained their influence in the wittena-gemote by their munificence. The king presided at this council, and sometimes, perhaps always, addressed them. In 903 we have an account of a royal speech. One of their duties was to elect the sovereign, and to affit at his coronation. Another was to co-operate with the king in making laws. The wittena-gemote appears also to have made treaties jointly with the king. Many instances occur to this purpose. The treaty, printed in Wilkins's Leges Anglie-Saxonice, p. 104, is said to have been made by the king and his witan. They are also mentioned as affitting the king in directing the military preparations of the kingdom. Impeachments of great men were made before the wittena-gemote. At these councils grants of land were made and confirmed; and the wittena-gemote frequently appears in the Saxons remains, as the high court of judicature of the kingdom, and it exercised power over the public guilds of the nation. The lands of the Anglo-Saxons, the burghs, and the people, appear in all the documents of our ancestors, as subjected to certain definite payments to the king as to their lords; and by a custom, whose origin is lost in its antiquity, among the Anglo-Saxons, all their lands, unless specially exempted, were liable to three great burdens, the building and repairation of bridges and fortifications, and to military expences. But what we now call taxation seems to have begun in the time of Ethelred, and to have arisen from the evils of a foreign invasion. Thus the payment of 10,000/ a year to the Danes to buy off their hostilities, mentioned by Henry of Huntingdon, and those which followed, are flated to have been ordered by the king and the wittena-gemote. Under sovereigns of feeble capacity, the wittena-gemote seems to have been the scene of these factions, which always attend both arifocracies and democracies, when no commanding talents exist to predominate in the discussions, and to shape the council. Turner's Hist. of the Anglo-Saxons, vol. ii. book 10. Littelton's Hist. Henry II. vol. iii.

WITTENBERG, in Geography, a town of Saxony, and capital of a circle or diocese, situated on the side of the Elbe, over which is a ferry: it is the head town of the electoral circle, the seat of an archiepiscopal court, of the afifle, as also a confistory, together with that of the general superintendancy of the electoral circle, a spiritual inspection, the circle ament, and a famous univerfity, founded in the year 1502, at which, in 1517, the Reformation took its rise by means of Martin Luther. This town is not large, but fortified. The old citadel was formerly the electoral residence; near it stands an arsenal. In the large round tower are kept the archives of the electoral and princely houses. The university library is kept in what was formerly an Augustinian cliff. The first founder of the town of Wittenberg was Bernard, duke of Saxony. In the year 1547, it was taken by the emperor Charles V.; in the year 1756, it was pollested by the Prussians, who also broke down a balion of the fortifications; 60 miles N. of Drefden. N. lat. 51° 55'. E. long. 11° 40'.

WITTENBERG, a town of Prussia, in Natangen; 8 miles N. of Heilberg.—Allo, a town of the duchy of Lauenburg, on the Elbe; 8 miles W. of Lauenburg.

WITTENBERGEN, a town of Brandenburg, in the Mark of Pregnitz; 6 miles S.S.W. of Perleberg. N. lat. 53° 2'. E. long. 11° 50'.—Allo, a town of the duchy of Holstein; 8 miles S.W. of Lutkenburg.

WITTENBURG, a town of the duchy of Mecklenburg; 17 miles W. of Schwerin.

WITTENHAUSEN, a town of the duchy of Holstein; 5 miles W. of Oldeburg.

WITTENSTEIN, a town of Prussia, in the province of Natangen; 10 miles S.S.E. of Königsgberg.

WITTGENAU. See WITGENAU.

WILMTHOE, a town of Africa, in the country of Cape Lopez Gonfalpo; 30 miles N. of Olbato.

WITTCHITHHAL, a town of Saxony, in the circle of Erzgebir; 7 miles S. of Schwanzenberg.

WITTINGEN, a town of Welfhalia, in the principality of Luneburg Zelle; 27 miles E. of Zelle.

WITTLICH, a lake of England, in the county of Huntingdon; 4 miles S. of Peterborough.

WITTICH, a town of France, in the department of the Rhine and Mofelle; 16 miles N.E. of Treves. N. lat. 50° 4'. E. long. 6° 52'.

WITTUMUND, a town of East Frieseland, on the Harle; 7 miles S.E. of Enges.

WITTSTOCK, a town of Saxony, in the county of Verden; 10 miles S.E. of Rosenthal.

WITTOBA, in Hindoo Mythology, is the name of the god Vishnu in one of his numerous descents, or avatars, as they are called. Some account of these avatars is given under our article Vishnu. This, now under decoration, was one of inferior importance; and not, it is said, of very ancient occurrence, and therefore not described in the Puranas, unless it be in the one supposed to be more modern than the rest, which is entitled Maha Bhagavat. (See Purana, and Sri Bhagavata.) A splendid temple is dedicated to the worship of Wittoba, or Vishnu, at Panderpoor, a town of great reputeability on the river Beemah, about 100 miles to the south-eastward of Poona. The manifellation is said to have appeared there. He is there represented sculptured in stone, of the size of a man, standing with his feet parallel to each other; his hands upon his hips, the fingers pointing forward, his thumbs backward. Two of the wives of Vishnu in his avatar of Krishna accompanied him in this; these were Rukmeni and Satyavama, and they have smaller temples at Panderpoor, besides others of their lords. (See Krishna, Rukmeni, and Satyavama.) Images of Wittoba are common in the Mahra ta country, generally of clumsy manufacture. Several representations of Wittoba and his wives are given in the Hindoo Pantheon, from calms and pictures. That work contains also a history of the avatar, and many particulars respecting it.

WITTOW, in Geography, a town of Germany, in the county of Verden; 10 miles S.S.E. of Rosenthal.
WITWALL, in Ornithology, a common English name for the great spotted wood-pecker, the *picus varius* major of authors.

WITZELRODE, in Geography, a town of Germany, in the county of Henneberg; 3 miles E.E. of Salmungen.

WITZELSTORFF, a town of Austria; 4 miles S.E. of Hoffmarckt.

WITZENHAUSEN, a town of Germany, in the principality of Hesse Rhenfels; 13 miles E. of Caizell. N. lat. 51° 10'. E. long. 8° 48'.

WIVELISCOMBE, a large market-town in the hundred of Wilt Kingsbury, and county of Somerset, England, is situated in a valley, at the distance of 11 miles W. from Taunton, 25 miles W. from Somerton, and 156 miles W. by S. from London. It appears to have been of some note under the Romans, though not distinguished in their annals as a station or military post. In the earlier part of their transactions in this island, they had a large castrum, or encampment, on a hill about a mile eastward from the town, which still is called the castle. Its summit contains about twelve acres; and though mostly covered with coppice-wood and bushes, the vestiges of fortifications, and the foundations of buildings, are yet discernible on its surface. Part of the fosse, which is very deep, and extended round the hill, has been destroyed by the working of a quarry. Near the centre of the area, a great number of Roman coins of various emperors were discovered in the beginning of the last century. The Danes, during their incursions into this county, availed themselves of this castrum, and after their departure, the Saxons, recovering their tranquillity, transplanted themselves to the adjacent vale, and gave their new habitation the name of Wiveliscombe. From this time it progressively became of importance, constituted the head of a large lordship, and was always held by the Saxon kings, till Edward the Confessor granted all the lands to the church of Wells. The bishops of that see had a flately palace here for nearly three centuries: it is now in ruins; a workhouse, erected in 1735, occupies a part of the ancient site. The town now consists of seven irregular streets; it is governed by a bailiff and portreeve, who are annually chosen in May. Here were formerly two markets, one on Tuesdays, the other on Saturdays; the latter only is now retained, with three annual fairs. A considerable woollen manufacture has been carried on for more than two hundred years, and still flourishes; the chief articles made are, blankets, knap-coatings, kerseys and other coarse cloths, shrouds, ermine, and baize. Many of these are sent to London, Bristol, and Exeter, for home consumption, and for exportation to Spain and Guernsey. The church is a plain structure, and consists of a nave and two aisles, with a tower and spire at the west end. The parish includes the town contains four small hamlets, and according to the population return of the year 1811 contains 574 houses, and 2550 inhabitants.—Collinson's History, &c. of Somersetshire, vol. ii. 1791.

WIVENHOE, a village of England, in the county of Essex, situated on the river Coln; it is the harbour of Colchester, and here is a custom-house. The oysters, called Colchester oysters, are barreled in this place. In 1811, the population was 7046.

WIZE, a river of England, in the county of Cumberland, which runs into the Wye.

WIZNA, a town of the duchy of Warsaw; 88 miles N.E. of Warsaw.

WIZUNY, a town of Lithuania; 20 miles N.N.E. of Wilkomiers.

WIZZARD, in Agriculture, a term applied in Norfolk to any particular sort of cart for farm-work.

WIZZENED, a term provincially applied to signify withered or shrivelled, as hay.

WLADELSLAW, in Geography, a town of Moravia, in the circle of Iglau; 12 miles S. of Meferitch.

WLADELSLAW, or Locovielaw, a town of the duchy of Warsaw, and capital of a palatinate of the same name, on the Vltava; the site of the bishop of Cujavia, removed from Krazschna in 1733; 108 miles N.W. of Warsaw. N. lat. 52° 35'. E. long. 18° 35'.

WŁODOWA, a town of Aultrian Poland; 18 miles N.E. of Chelm.

WŁODZIMIERZ, a town of Poland, in Volhynia, on the Bug; the site of a Greek bishop, united to the church of Rome; 48 miles W. of Luckow.

WOAD, in Agriculture, a plant cultivated in the field for the use of the dyers. It is a plant which has a strong thickish fibrous root, which penetrates deep into the soil, and is principally raised for the use of the leaves, which, after being properly manufactured, are made use of in the art of dyeing to produce a blue colour, as well as the baize of black, and some others.

Soil.—It is evident from the nature of its root that it requires a soil which has much depth or staple, and which is perfectly fresh, such as those of the rich, mellow, loamy, and deep vegetable kind. Where this sort of culture is carried to a considerable degree of perfection, as in Lincolnshire, the deep, rich, putrid, alluvial soils on the flat tracts extending upon the borders of the different large rivers are chiefly employed for the growth of this sort of crop; and it has been shown by repeated trials that it answers most perfectly when they are broken up from a state of fward immediately for it. In some places, it is the practice to take lands of this description at high prices, for the purpose of breaking them up and growing it upon them for two or three years; on the more low rich soils, for four years, but on those of lefs fertility only for three; and in some, which are more elevated and exposed, two are considered sufficient. For this sort of culture, people are employed, who move from place to place, and form a sort of colony. Mr. Cartwright, in the above county, has however found, that it is capable of being confined to one spot with equal or greater success, by having a sufficient extent of ground for changing the place of its growth as may be necessary, and for appropriating an adequate proportion annually to the raising of the plant, by which the houses and expensive machinery that are necessary for its preparation may be kept constantly and regularly employed in the busines.
tion. In cases where the soils are sufficiently dry, only breaking them up early in the month of February; and where the contrary is the case, deferring it to a later period, taking care to plough the land in a perfect manner to the depth of five inches, or more: and that the furrow-slices may be well turned, laid flat, and nicely jointed, a person is employed with a spade for the purpose of adjoining them. This prevents the gritty matters from rising in the seams. When this has been done, the surface is repeatedly harrowed over, to raise a sufficient depth of good mould for the drill to work in; and before the feed is put in a roller is passed over the land.

It is probable, however, that this method is inferior to the former, as the land is not brought nearly to so fine a flate of mould, or the gritty material so effectively covered and destroyed, from which injury may be done to the woad plants in their early growth.

But a method which is equally effectual with the first, more expeditious, and which has a superiority over it, in more completely destroying grubs, insects, and other vermin, which are apt to feed on the plants in their early growth, is that of paring and burning. This is, however, chiefly practised where the soil is rough, and abounds with rufhes, fedge, and other plants of the coarse kind, but might be had recourse to on others, with vast benefit.

Where the latter modes are made use of as soon as the feed has been put in, the land should be carefully drained by forming grips in suitable directions, as wherever water flag-nates, the woad plants are liable to be injured or destroyed.

Seed.—In respect to the feed, it should be collected from ground that has been left covered with the beet plants from the preceding season, as they only run up to item and form seeds in the second year; and in order to have good feed, the leaves should not be cropped at all or but once, the items being suffered to remain till the seeds in the husks become perfectly ripened; which is shown by their attaining a brownish-yellow colour, and the pods having a dark blackish appearance. It should then be gathered as soon as possible, by reaping the items in the manner of grain, and then spreading them in rows thinly upon the ground if the weather be fine, when in the course of a few days they will be in a flate to be threshed out from the husks or pods. When they are suffered to remain too long, the pods are liable to open, and shed the feed. Although the pod in which the seeds are contained is of a large size, the seeds are less than those of the turnip. New feed, where it can be procured, should always be sown in preference to such as has been kept for some time; but when of the latter kind, it should be sowed for some time before it is put into the ground.

In regard to the quantity of feed which is necessary, it must be regulated by the soil, and the manner in which it is sown. Where the drill is employed, less will be required than in the broad-calf method. It has been found that a rood of land, where the crop is good, will in general afford feed sufficient for eight or ten acres; and in some cases, in the broad-calf method, five or six bushels are made use of to the acre. In Kent they use ten or twelve pounds to the acre.

Sowing.—The time of sowing crops of this nature must be regulated, in some degree, by the mode of preparation that has been employed. Where the first of the above methods has been followed, it will be much later than in the other cases. But early sowing is in general to be preferred, as there will be less danger of the plants being injured by the attacks of the fly or grub. Where the weather is suitable, and the land in a proper state of preparation, the feed may be sown in the latter end of February or March, continuing the sowings, in different portions of land, till about the middle of May, at suitable intervals of time to vary the times of cropping the leaves of the plants. The late sowings are commonly executed about the latter end of July, or early in the following month at the farthest.

With respect to the manner in which the feed is sown, it differs according to the nature and state of preparation of the land. Where it is in a fine state of mould, the drill or row method is the method mostly practised, which is by much the best, as by it the plants may be kept more easily clean and free from weeds, becoming more strong and vigorous, from the earth being more stirred about the plants; but where the contrary is the case, the broad-calf mode is generally followed; but which does not by any means admit of the plants being kept free from weeds, or the mould so well stirred about the roots of them.

Where the first method is had recourse to, the feed is sown by a drilling-machine, such as is used for turnips, in equidistant rows, eight or nine inches apart, covering it in, either by means of a harrow attached to the implement, or by paffing a light common harrow over the ground afterwards, once in a place, raking off any clods that may be present to the sides, or into the furrows: but in the latter mode, it must be delivered by the hand in as equal a manner as possible, over the whole of the land, being then harrowed in by a light harrow, so as to leave the land in as even and level a state as possible. The ground is frequently rolled afterwards, that the surface may be left as even as possible.

In favourable seasons with good feed, the plants mostly appear in the course of a fortnight, when much attention should be paid to see that they are not destroyed by the turnip-fly, or the frosts inThose of the more early sowings, as, where that is the case, the land should be immediately re-sown; as in some cases it is not uncommon to sow the greatest part of the crop two or three times over. In the very late sowings, where the crops rife thin on the ground, it is sometimes a practice to give a better plant by forming holes with a hoe in the vacant spots, and directing seeds to be dropped into them by the hand by women or children. This is the case with the late spring-sowings till the beginning of June, or a later period.

Culture while growing.—From much of the goodness of the woad plants depending on the luxuriance of their growth, and the thicknes of their leaves, it is necessary to bestow great attention in the culture of the crop while growing. It is advised that the spring-sown crops, as well as those that are sown in the latter part of the summer, should have the first hoeings given them as soon as the plants are fully distinguishable above the ground, as by this means the weeds will not only be prevented from retarding the vegetation of the plants, but these by being thinned out to greater distances be more at liberty to advance and become vigorous in their first or early growth, which is a matter of much consequence to the success of the crop; and second hoeings should be given in the course of four or five weeks afterwards, when the plants should be thinned out to the full distances at which they are to stand, which may be six inches or more, according to the goodness of the soil, constantly leaving sufficient room to prevent the plants from being in any way crowded. The work is sometimes executed in much the same manner as for turnips, by hand-hoes; but in others by small short spades, used with one hand, while the other is employed in clearing away the weeds; the labourers, mostly women and children, kneeling while they perform the work. When this work has been done, nothing further is necessary till the first cropping of the
the leaves has been performed, when the plants should be again immediately well weeded; and after each cropping the same operation be had recourse to; the extent of crop cleared in the day being, in most cafes, weeded before night.

With the late-fown crops, after the second weeding in October, nothing further will be requisite till the spring, about the middle of April, when the work should be again well executed, the mould being completely stirred about the roots of the plants, that they may derive the fullest benefit from the operation. This will be sufficient to keep them clean till the taking of the first crop; after which they must be again weeded, and the same operation be had recourse to after cropping of the leaves, as in the above cafe.

In respect to the busines of gathering the crops with the spring-fowled ones, the leaves will generally be ready to be gathered towards the latter end of June, or beginning of July, according to the nature of the soil, season, and climate; but for those put in a later period in the summer, they are often fit to be gathered earlier. This business should, however, constantly be executed as soon as the leaves are fully grown, while they retain their perfect green colour, and are highly luminous; as when they are let remain till they begin to turn pale, much of their goodnes is lost to be expended, and they become less in quality, and of inferior quality for the purposes of the dyer. In valuable seafons, where the foils are rich, the plants will often rise to the height of eight or ten inches; but in other circumstances they seldom attain more than four or five; and where the lands are well managed in the culture of the plants, they will often afford two or three gatherings, but the best cultivators seldom take more than two, which are sometimes mixed together in the manufacturing of them. It is necessary that the after-croppings, when they are taken, are constantly kept separate from the others, as they would injure the whole if blended together, and considerably diminish the value of the produce. It is said that the best method, where a third cropping is either wholly or partially made, is to keep it separate, forming it into an inferior kind of woad.

Upon an acre of land, when well managed, in valuable seafons, the product is mostly from about a ton to a ton and a half. The price varies considerably; but for wood of the prime quality, it is often from twenty-five to thirty pounds the ton, and for that of an inferior quality fix or seven, and sometimes much more.

Seeding-Crops.—With such parts of the crops as are reserved for seed, it is a practice with some to crop the leaves two or three times the first year, and then leave the plants to run up to feed in the following one, but it is a better practice to only remove the side-leaves, as in this way the plants are less weakened, and the produce of the seed much increased. The plants are likewise sometimes fed down by sheep during the winter; but this, from its tendency to weaken them, is equally improper and prejudicial.

Preparation of for the Dyer.—The woad, after it has been gathered, undergoes several processes to prepare it for the dyer; but in the improved method it is conveyed in one-horse carts, to contrived as to be lifted from the axis, and, by folding doors in the bottoms, to discharge their contents upon the floor above the mill, on being hoisted up to their proper situation: round this floor holes are formed for putting the plants down through, in order that they may drop under the grinding-wheels. The wheels for this purpose have several wheels for grinding the plants, which have sides diameters on one side than the other, and are about three feet in width, being constructed with iron bars for crushing the woad. They are wrought by horse, or any other power, as may be the most convenient. The materials are preferred under the grinding-wheels by proper contrivances, which, as soon as they are sufficiently reduced, force it out of the tracks upon the fome floors on the fides; thus making way for new parcels without the mill being stopped. The bruised woad is then thrown into rooms on the sides of the mill, destined for its reception, by means of shovels. In these it remains till the juice is so much drained off as to leave it in a proper condition for being formed into balls; which is done by labourers, with apparatus for the purpose, and then laid upon trays to be conveyed to the drying ranges, in which they are placed upon gratings-thales that slide on sledge in the drying-houses. These are placed on the sides of galleries, for the convenience of being easily deposited upon them and removed again. It is kept in these till it is sufficiently dried to be laid up in other rooms, until the whole of the crop has undergone the same operations, and the workmen are ready to manufacture it.

It is stated in the Corrected Lincolnshire Report on Agriculture, that to prepare it for use in the art of dyeing, it is necessary for it to take on a proper state of fermentation, which is accomplished in the course of seven or eight weeks, and, in the technical language of the art, is termed couching. It is effected by regrinding the balls, in the same mill as before, to a fine powder, and then spreading it upon the floors of the rooms in which the balls were formed, to the thickness of about three feet; where it is then moistened with water, so as to keep it in a proper flow state of fermentation; and so managed by turning that it may pervade the whole in an equal manner. In this business, the direction of an experienced workman is necessary. In the turning, it is of much importance that the parts of the materials be perfectly divided, which can only be effected by a nice management of the shovel: and it is added that much advantage has been found in the goodness of the woad, from the drying and floring of it being performed in a careful manner. When this attention is neglected, the woad will not, on being broken between the finger and thumb, draw out into fine hair-like filaments, or, in the technical language of the manufacturer, beaver well; as the use of this substance in the blue vat of the dyer, is not merely to afford the colour of the plant, but, by bringing on a very gentle fermentation, excite the indigo in the same vat to yield its colouring principle more perfectly. This is even necessary for its own colouring-matter being fully imparted. The substance should, therefore, be so prepared in the different operations as to produce this effect in the most certain and perfect manner. When the heat in the processes of couching has gone too far, the substance will be what is termed fare; and when it has not proceeded to a sufficient degree, it will be what is called beaver. If the material be good, it does not fell the fingers on being rubbed between them; but such as is heavy does. In the conclusion of the process, the cooling is effected in a gradual manner, as to render it not fit for taking on the same process; and of course proper for being preferred in calks, or in any other way. It is then ready for use.

The preparation of woad for dyeing, as practised in France, is minutely described by Aliiue, in his Memoirs for a Natural History of Languedoc. The plant puts forth at first five or six upright leaves, about a foot long, and an inch broad; when these hang downwards, and turn yellow, they are fit for gathering: five crops are gathered in one year. The leaves are carried directly to a mill, much resembling the oil or tan-mills, and ground into a smooth pale. If this process was deferred for some time, they
they would putrefy, and lend forth an insupportable stench. The palate is laid in heaps, pressed close and smooth, and the blackish crust, which forms on the outside, reunited if it happens to crack; if this was neglected, little worms would be produced in the cracks, and the wood would lose a part of its strength. After lying for fifteen days, the heaps are opened, the crust rubbed and mixed with the inside, and the matter formed into oval balls, which are pressed close and solid in wooden moulds. These are dried upon hurdles: in the fun, they turn black on the outside; in a close place, yellowish, especially if the weather be rainy: the dealers in this commodity prefer the first, though it is said the workmen find no considerable difference between the two. The good balls are distinguished by their being weighty, of an agreeable smell, and when rubbed of a violet colour within. For the use of the dyer, these balls require a farther preparation: they are beat with wooden mallets, on a brick or stone floor, into a groats powder; which is heaped up in the middle of the room to the height of four feet, a space being left for passing round the sides. The powder, moistened with water, ferment, grows hot, and throws out a thick fétid flame. It is shovelled backwards and forwards, and moistened every day for twelve days; after which it is stirred less frequently, without watering, and at length made into a heap for the dyer.

The powder thus prepared gives only brownish tinctures, of different shades, to water, to rectified spirit of wine, to volatile alkaline spirits, and to fixed alkaline liquitä: rubbed on paper, it communicates a green stain. On diluting the powder with boiling water, and after standing some hours in a close vessel, adding about one-twentieth part of its weight of lime newly flaked, digesting in a gentle warmth, and stirring the whole together every three or four hours, a new fermentation begins, a blue froth arises to the surface, and the liquor, though it appears itself of a reddish colour, dyed woollen of a green, which, like the green from indigo, changes in the air to a blue. This is one of the nicest processes in the art of dyeing, and does not well succeed in the way of a small experiment.

Atricle propoies the manufacturing of fresh wood leaves in Europe, after the same manner as the indigo plant is manufactured in America; and thus preparing it from a blue specula similiar to indigo, which from his own experiments he has found to be practicable. Such a management would doubtless be accompanied with some advantages, though possibly wood so prepared might lose those qualities which now render it, in a large basins, preferable on some accounts to indigo, as occasioning greater dispatch when once the vat is ready, and giving out its colour less hastily, so as to be better fitted for dyeing very light shades. Neumann's Chem. by Lewis, p. 437, &c.

The ancient Gauls and Britons used to dye or stain their bodies with this plant, and were probably led from this application of it to use it for dyeing cloth.

Some hold that it was from this plant glass took its denomination; though others derive both glas and gladium from the Britth glas, which to this day denotes a blue colour. See Glass.

A wood blue is a very deep blue, almost black; and is the base of so many sorts of colours, that the dyeers have a scale, by which they compose the divers calls or degrees of wood, from the brightest to the deepest.

WoAD, in Botany. (See Isatis.) There are four species.

The broad-leaved wood is cultivated in several parts of England for the purposes of dyeing, being used as a foundation for many of the dark colours.

Some seed down the leaves of woad in winter with sheep; a practice which Mr. Miller condemns.

Woad grows wild in some parts of France, and on the coasts of the Baltic sea: the wild wood, and that which is cultivated for the use of dyers, appear to be of the same species.

Befide the plant properly signified by the name woad, which dyes a blue colour, we have two others known in our English herbalts under that name, as also that of wold or weld. These are both called by the common people dye of the ved, and are the luteola and the genista tinctoria.

The ancients confounded all these three plants also under the same names. Paulus Ægineta seems to make them all the same plant; and Neopbythus, speaking of the isatis, or our wood, properly so called, says, that it was called by the Latins luti. This luti has been by some understood to mean the luteola, and by others the genista tinctoria; but the latter opinion only is right, for it is described to us by the ancients as having leaves like the linum, or flax, and flowers like the broom.

WoAD-Mill and House, that sort of mill and house which is necessary and proper for preparing and fitting this kind of substance for the use of the dyer. The representation of a mill and excellent apparatus for effecting the preparation of the wood plant, which is made use of by Mr. Cartwright, with much success and advantage, in Lincolnshire, may be seen in the second volume of the "General Dictionary of Agriculture and Husbandry."

WOAHOO, or OAHOO, in Geography, one of the Sandwich islands; as far as could be judged from the appearance of the north-east and north-west parts, it is much the finest island of the whole group. Nothing can exceed the verdure of the hills, the variety of wood and lawn, and rich cultivated valleys, which the whole face of the country displayed. The road is formed by the north and west extremities. Should the ground-tackling of a ship be weak, and the wind blow strong from the north, to which quarter the road is entirely open, this circumstance might be attended with some danger; but with good cables, there would be little risk, as the ground from the anchoring-place, which is opposite to the valley through which the river runs to the north point, is a fine land. This island is supposed to contain 60,000 inhabitants. N. lat. 21° 43'. E. long. of the anchoring-place 202° 9'. See SANDWICH ISLANDS.

WOALDS, in Agriculture, a term not unfrequently applied by writers on husbandry to crops of the woad kind. See WOAD.

WOAPO, in Geography, one of the Ingraham islands in the Pacific ocean. Captain Ingraham called it Adams. It was afterwards visited by captain Roberts, who named it Jefferson. S. lat. 9° 27'.

WOBBEL, a town of Westphalia, in the county of Lippe; 6 miles E.N.E. of Holstein.

WOBURN, or WOObURN, or Bishop's Wooburn, a village in the hundred of Delborough, Buckinghamshire, England, is situated in a narrow valley, at the distance of 3 miles W.S.W. from Beaconsfield, and 26 miles W. by N. from London. The manor of Bishop's Woburn had from time immemorial belonged to the see of Lincoln, till the year 1547, when bishop Holbeach gave it to the crown in exchange. It was granted in 1549 to John, earl of Bedford. In the 17th century it came by marriage to Philip, lord Wharton, whose son and grandson, the celebrated marquis and duke of Wharton, successively held it. After the death of the latter, it was sold to the Berries; from whom it was purchased, in 1784, by Mrs. Dupré, mother
mother of James Dupré, esq. of Wilton-park, who is the present proprietor. The old manor-house was a palace of the bishops of Lincoln, several of whom died here. The marquis and the duke of Wharton are said to have expended incredible sums of money on the house and gardens: of the latter, which in a former age were highly celebrated, scarcely a vestige now remains. The mansion was pulled down in 1759 when one of the wings was fitted up as a dwelling-house, which has since been enlarged and improved, and is now occupied by the countefs of Orkney. The parish church is a spacious and ancient structure, with a nave, two aisles, and a tower. The latter was built about the year 1480, as appears by the epitaph of John Goodwin and Pernell his wife, who are called its founders. In the chancel are several monuments of the families of Bertie and Wharton, among which is one of grey marble to the memory of Philip, lord Wharton, who died in 1695. The font is a curious piece of ancient sculpture. This parish contains 2596 acres, chiefly disposed in arable and woodland. In the year 1811, the inhabitants were estimated at 1604; the number of houses at 318. An annual fair is held, for which lord Wharton obtained a charter in 1586. A fair was also granted by king Henry VI., but is now discontinued.—Beauties of England and Wales, vol. i. Buckinghamshire. By J. Britton and E. W. Brayley, 1802. Lyons' Magna Britannia, vol. i. Buckinghamshire, 1806.

WOBURN, or Old Woburn, a market-town in the hundred of Manhead, and county of Bedford, England, is situated near the western confines of the county, at the distance of 14 miles S.W. by S. from the county-town, and 42 miles N.W. by N. from London. Great part of the town was consumed by fire in 1724, which, though distressing to individuals, proved ultimately beneficial, as the houses were rebuilt in a more convenient and regular manner, with the addition of several good inns, and a market-house. The whole expense of the new buildings was defrayed by the duke of Bedford. The market-house was finished in 1737, but has been materially improved by the late duke Francis. It consists of two floors; the lower fitted up for butchers' shambles, over which is a spacious room for a corn-market. In the population return of the year 1811, the inhabitants of the parish are stated to be 1506, occupying 299 houses. A weekly market is held on Fridays, which was granted in 1242 to the abbot of Woburn, and four fairs annually. The church was erected by Robert Hobbs, the late abbot of Woburn. This structure furnishes a peculiar instance of capricious taste; the body being completely detached from the tower, which stands at about six yards distance. The tower is a small square building, with large buttresses at the corners, and four pinnacles; the church consists of three aisles and a chancel; the whole has recently undergone a thorough repair. Adjoining to the church-yard is a free-school, founded by Francis, earl of Bedford. Here are also almshouses for twelve poor persons, founded by the Bedford family, and endowed with 50l. per annum, which was confirmed by act of parliament in 1761.

About a mile east of the town is Woburn abbey, the seat of the duke of Bedford. This magnificent mansion is situated in the midst of an extensive park, and occupies the four sides of a quadrangle of more than 200 feet. It was erected about the middle of the last century by Flintcroft, for John, the fourth duke of Bedford, of the Ruffel family, on the site of an old abbey. The original building was founded in the year 1145, by Hugh de Bolebec, for monks of the Cistercian order. In 1234 the monastery was so reduced, that the establishment was for a time broken up, and the monks dispersed into different convents till their debts were paid. But by various benefactions their revenues were so much improved, that at the general dissolution they were estimated at 3017. 18s. 2d. clear yearly value. The late abbess was hanged for denying the king's supremacy. The feite of the abbey was granted in 1547 to John, lord Ruffel, afterwards earl of Bedford, and has ever since been the principal seat of that noble family. There are no remains of the conventual buildings. The present manor, originally fitted up in a very costly style, has received many considerable improvements, particularly during the time it was in the possession of the late duke. Mr. Holland, the architect of Drury-lane theatre, has displayed much taste and ability in the additional buildings which have been executed under his direction. The west front is built of the Ionic order, with a rusticated basement. The principal floor, or suite of rooms on this side, consist of a saloon, flat bed-rooms, drawing and dining-rooms; the south side contains the library, breakfast, Ettruscan, and duke's rooms; the cell, the vestibule, servants' offices, &c.; and the north, the French bed-rooms, and various other chambers. Most of the apartments are embellished with fine paintings: the gallery, in particular, exhibits a large and valuable collection of portraits by the old masters. The late duke's favourite pursuits are well known to have been experimental agriculture and breeding of cattle. For this purpose he kept several farms in his own hands. The principal of these, distinguished by the name of the Park-farm, is situated in the park, about half a mile from the house. All ingenious contrivances to shorten labour, and facilitate useful operations, are here concentrated. The farm-yard is replete with conveniences. It contains barns, stables, fattening-houses, &c.; a very complete mill, furnished with a curious machine which thrashes and dries at the same time a malt; two pairs of rollers for grinding wheat and barley; and every requisite for dressing flour, making oatmeal, &c. In another part is a small water-wheel, which gives motion to some very ingenious machinery for bruising malt, and cutting chaff. This farm originated with the late duke, through whose patronage and exertions many improvements have been made in the different branches of husbandry. The present duke follows the steps of his brother in patronizing agricultural improvements, and keeps up all the establishments which he formed with a view to that purpose.—Beauties of England and Wales, vol. i. Bedfordshire. By J. Britton and E. W. Brayley, 1801. Lyons' Magna Britannia, vol. i. Bedfordshire, 1806.

WOBURN, a town of the state of Massachusetts, in the county of Middlesex, containing 1777 inhabitants; 15 miles N.W. of Boston.

WOCANELLY, a town of Hindoostan, in Golconda; 40 miles N.W. of Adou.

WODEN, in Mythology. See ODIN.

WODERCUM, in Geography. See WORCUM.

WODNANY, or WODNIAN, a town of Bohemia, in the circle of Prachatitz; 12 miles N.E. of Prachatitz. N. lat. 49° 10'. E. long. 14° 2'.

WODWALLA, a town of Sweden, anciently a port, but now much reduced, and its privileges removed to Gothenburg, at eight miles distance.

WOEL, a town of France, in the department of the Meuse; 12 miles N.E. of St. Mihel.

WOELFLIES, a town of Saxony, in the principality of Gotha; 21 miles S.E. of Gotha.

WOERAMATTA, a small island in the East Indian sea. S. lat. 7° 2'. E. long. 131° 36'.

WOERDEN, or WEDREN, a town of Holland, built by
by Godfrey de Rhenen, the twenty-eighth bishop of Utrecht, on the river Rhine, about the year 1160, to keep the citizens of Utrecht in subjection, and maintain his authority. It had a castle, which was formerly suppofed to be im-
pregnable; but when the French took the city in 1672, they entirely demolished it, before that time falling to
decay. This city had its own particular lords till the year 1296, when Herman de Woerdem fortified it, having been
convicted of being a party in the murder of Florent V. comte
of Holland, who was affaiinated by a gentleman named Ger-
ard de Velfen, whose wife he had ravished. It was after-
wards fold by Philip II. king of Spain, to Eric, duke of
Brunswick; from whom it came, in 1581, under the dom-
inion of the States-General. In 1672, the French having made
themselves masters of this place, the Dutch came to
besiege it, under the prince of Orange and the comte de
Zuylfeiten. The comte de Mareck, who commanded in the
city, began to be much prefied, when the duke of Luxem-
burg arrived with 9000 men. He passed the morafs by a
way which was suppofed to be inaccessible, forced the
intrenchments, and put the enemy to flight. The Dutch
left 2000 men, killed and wounded, among the former of
whom was the comte of Zuylfeiten; and the French about
1000; 8 miles W. of Utrecht.

WOGGORA, a small high province of Abyssinia, on the
E. of Gondar, which is town with wheat. This province
and Dembea are the granaries of the country.

WOGLT, a river of Auffria, which runs into the Ager,
near Voglabruck.

WOGGYDURGAM, a town of Hindooftan, in My-
fore; 15 miles S. of Ouoffi.

WOLOW, a town of Pruffia; 18 miles S. of König-
berg.

WOGLSHAID, a town of Auffria; 7 miles S.W. of
Aigen.

WOHLAU, a town of Silefia, and capital of a principal-
ity, on all fides surrounded with mafhines, which are a kind
of natural defence. It has two suburbs, a Roman Catholic
and a Lutheran church. In the year 1640, it was taken by
the Swedes; in 1642, furprifed by the Imperialifts, but soon
after retaken by the Swedes; and in 1644, recovered by the
Imperialifts; 20 miles N.W. of Breflaw. N. lat. 51° 20'.
E. long. 16° 35'.

WOHLAU, or Wolau, a principality of Silefia, bound-
ed on the north by the principality of Glogau, on the
east by Poland and the principality of Oels, on the south by
the principalties of Breflaw and Lignitz, and on the west
by the principalties of Lignitz and Glogau; situated on
both fides of the Oder. The foil is in some parts dry,
in others marfhy, or overrun with woods and bufhes, though
several tracts also yield good corn.

WOHRA, a river of Germany, which runs into the
Werra, 2 miles N.W. of Echweugen, in the principality of
Hefie.

WOHRD, a town of Bavaria, in the territory of Nu-
remberg, near Nuremberg.

WOINTSCH, a town of Austrian Poland; 36 miles E.
of Cracow.

WOITSBACH, a town of Bohemia, in the circle of
Boleflaw; 8 miles E. of Krottau.

WOITSPERG. See Voitsberg.

WOKING, a town of England, in the county of Surrey;
8 miles N. of Guildford.

WOKINGHAM, or OARKINGHAM, a market-town and
parish in the hundred of Sonning, and county of Berks,
England, is situated in Windsor forest 71 miles E.S.E.
from Reading, and 32 W.S.W. from London. The po-
pulation in 1811 was 2085 persons, inhabiting 435 houles.
The market is held on Tuesday, and the fairs on the 23d of
April, 11th of June, 1oth of October, and 24 of November.
The town, incorporated by James I., is governed by an alde-
man, high steward, recorder, burgifes, and a town-clerk;
and at this place are held all the courts for Windsor foreft.
Although within the bounds of Berkshire, the church stands
in an infalted part of Wiltfhire: it is a large and handsom
edifice. The inhabitants are chiefly employed in agriculture,
throwing filk, forting wool, and making shoes: the gauze
manufacture was some years ago introduced. At Luckely-
green, near this town, is an hopital, founded in 1665 by
Henry Lucas, efq. for sixteen poor men and a mafter: the
truftees of the charity are the Drapers' company of London.
About four miles S.E. from Wokingham, is a large and irre-
gular fortification, with a double ditch, commonly called
Czar's camp, situated on the summit of a hill. Half a mile
thick the southward of this camp is the Devil's ditch, a raifed
road nearly ninety feet wide, running eaf and weft, with
a trench on each fide. In 1661 George Staveron gave the
rent of a houle in this place for the purpoze of buying a
bull, to be bated and killed at Chriftmas, for the benefic
of the poor of Wokingham: but this being thought insufficent,
the inhabitants are in the habit of purfuing another beast
for the fame purpoze. Archbifhop Laud gave a portion of
certain fee-farm rents, which produces about 40l. per annum,
to the parifh. Every third year it is divided, purfuant to
the donor's intention, between three poor maidens of the
age of eighteen, natives of the town, and members of the
church of England, who have ferved the fame mafter or
milkfes for three years together: the other years it is ap-
propriated to the apprenticing of poor boys. Dr. Thomas
Godwin, biſhop of Bath and Wells, was a native of this
town, where he was born in 1517.

About four miles S. from Wokingham is Billingbear, one
of the feats of lord Braybrooke. The houfe is a large irre-
gular building, feated in a fine park. A particular history
and defcription of this place is given, with a view, in Havell's
Views of Seats, folio, 1816.—Beauies of England and
Wales, Berkshire; by J. Britton and E. W. Brayle,
D. Lyfons, vol. 1. 4to. 1806.

WOKSCHITZ, a town of Bohemia, in the circle of
Königiratz; 2 miles W. of Gotichin.

WOLBECK, or WOLDBEK, a town of Germany, in the
bifhropic of Münfter; 7 miles S.S.E. of Münfter.
N. lat. 51° 53'. E. long. 7° 52'.

WOLBORZ, a town of the duchy of Warsaw; 41 miles
S. of Siradia.

WOLCHRADITZ, a town of Moravia, in the circle of
Brunn; 18 miles S.S.E. of Brunn.

WOLCENSTEIN, a town of the duchy of Stria; 6
miles W.N.W. of Rottemann.

WOLCERSDORF, a town of Germany, in the mar-
grave of Anfachz; 2 miles N. of Schwabach.—Alfo, a
town of Auffria, on the Rufchz; 8 miles E.N.E. of Korn
Neuburg.

WOLCERSHAUSEN, a town of the duchy of Wurzburg; 6 miles N. of Schweinfurt.—Alfo, a town of the
county of Henneberg; 3 miles N. of Menungen.

WOLCOTT. See Woolcott.

WOLCOTT, a town of Connecticut, in the county of
New Haven, near Fairfield, with 952 inhabitants.

WOLD, signifies a plain, down, or open champaign
ground, hilly, and void of wood.

Hence the names Stow in the Wold, and Cotwold, in
Vol. XXXVIII.
Gloucestershire; whence also that part of Leicesthshire, which lies northward beyond the Wrekin, is called the Wald of Leicesthshire.

**WOL**

WoL, or W old, among D yers. See W eld.

WOLDECGE, or W olddeck, in Geography, a town of the duchy of Mecklenburg; 13 miles S.E. of New Brandenburg.

WOLDENBURG, a town of the New Mark of Brandenburg; 9 miles N.E. of Friedburg. N. lat. 53°. E. long. 15°. 45′.

**WOLEIN.** See MIIZIN.

WOLSELEITZ, a town of Bohemia, in the circle of Kauzrin; 4 miles W.S.W. of Kauzrin.

WOLF, CHRISTIAN, in Biography, an eminent mathematician and philosopher, was born at Breflau in 1679, and well educated under able masters in different branches of literature and science. At the age of 21, he was entered at the university of Jena, which was then in high reputation; and quitting Jena in 1702, he prosecuted his studies at Leipsic, where, in the following year, he took his degree of master of arts, publishing on the occasion a dissertation, intitled "Philosophia practica Universi Mathematico modo coniectans." In 1704, he published another dissertation, on the differential and infinitesimal calculus. Having studied theology as well as philosophy at Leipsic, he officiated as a preacher; and being invited to undertake the office of pastor in a country village, he was advised by Leibnitz to decline it, and to pursue the study of philosophy. As he commenced his literary career with great reputation, he was proposed to be an associate in the periodical work, intitled "Ata Eruditorum;" and in this connection he continued for many years, employing his leisure hours in teaching mathematics, logic, and natural philosophy. When the Swedes made an incursion into Saxony in the year 1706, he quitted Leipsic, and removed to Berlin, where a recommendatory letter of Leibnitz procured for him from Frederic I. the office of professor of mathematics at Halle. In 1709 he published, in Latin, his treatise on "Aeronomy," and in the following year his "Elements of Mathematics," in 4 vols, which have passed through several editions. Having composed a very ingenious essay on the intense cold of the ensuing winter, he was elected a member of the Royal Society of London, and soon after a member of the Academv of Sciences at Berlin. In 1711 he published his tables of sines and tangents, and in the next year his treatise on logic, in German, highly commended by Forney, and translated into Latin, French, and other languages. The first two volumes of his large work on the mathematics appeared in 1713, and these were afterwards followed by three more. By the advice of his friend Leibnitz, he refused an invitation from Peter the Great to remove from Halle to Peterboug. On the death of Leibnitz in 1726, Wolf drew up his life, which supplied Fontenelle with materials for his eloge. In 1718 he published "Meditations on God, the World, and the Human Soul," which were reprinted in the following year. About this time the reputation of Wolf and the jealousy of his rivals occasioned a literary contest, which lasted for a considerable time, and which was not very honourable to either party. Wolf having delivered a dissertation on its quitting the pro-rectorate of Halle university in 1721, on which he took occasion to compare his own principles with those of Confocian and the Chinesc, and having announced the opinion which he entertained on the doctrine of neccesity, an outcry was raised against him, and he was represented by his enemies as a man whose principles tended to atheism, and to corrupt the morals of the people. Notwithstanding this malignant attack, he employed himself in publishing three volumes of experimental philosophy, and a volume of dogmatical philosophy, which he dedicated to the emperor of Russia, and which the emperor caused to be translated into the Russian language, repeating to him the offers which had before been made, in order to induce him to remove to Peterboug. The contest that had been excited against him still continued; and though he attempted to justify himself in a treatise on the subject of fatality, the king was at length persuaded that his principles were dangerous, and ordered him, in November 1725, to quit his territories in two days, under pain of death. Wolf immediately proceeded to Caffel, where he met with the king of Sweden, who appointed him professor of mathematics at Marburg, an office which he had refused sixteen years before. The clergy of Halle pursued him with their enmity and opposition to Marburg; but Wolf was suffered to remain in the quiet enjoyment of his office during his residence at that place. Several students who attended him at Halle followed him thither, and his lectures, which he commenced in 1724, were attended by pupils from all parts of Europe. His mind being now undisturbed, he resumed his literary labours, and published his "Remarks on Metaphysics," in which he answered the principal objections against his doctrine, and gained a decided victory over his enemies. The grounds of the cenfure that had been passed on Wolf had been everywhere canvassed; and almost every German university was inflamed with disputes on the subject of liberty and necessity, so that the names of Wolfian and anti-Wolfian were everywhere heard. Wolf, having thus vindicated his philosophy from reproach, received new invitations from Peterboug and Leipsic; but gratitude to his protector induced him to remain in his situation at Marburg, which he found to be very agreeable, and to afford him leisure for pursuing his speculations. After an interval of nine years, the current of public opinion turned in favour of Wolf, and he now received numerous tokens of respect from men of rank and learning; and in 1733 he was invited to fill, in the Academy of Sciences, one of the eight places allotted to foreigners distinguished in the highest branches of science. On this occasion, Reaumur and he commenced an intimate friendship, which lasted till the time of his death. The king of Prussia was convinced of Wolf's innocencs, revered his sentence of exile, and wished to repair the injury which he had sustained. He made tempting offers, both of title and money, to induce him to return to Halle; but he declined the acceptance of them; as he also refused an invitation from George I. of England to accept a place in the new academy which he had founded at Gottingen. The clergy of Halle made some other attempts to reproach and ruin him, but they recoiled on his adversaries. In the year 1740, he prefixed to the first volume of his "Droit Naturel, et Traitte sur le Law of Nature," a dedication to the hereditary prince of Prussia, afterwards Frederick the Great, which was acknowledged by a very flattering letter.

Frederick the Great, as soon as he ascended the throne, recalled Wolf to Halle; and with the permission of the king of Sweden, he consented to accept the office of professor of the law of nature and nations, and also of mathematics, with a salary of 2000 crowns, and liberty to teach whatever he thought proper. He obtained also the rank of privy-councillor, and was made first vice-chancellor, and afterwards chancellor of the university. In 1745 he was created a baron by the elector of Bavaria. Wolf was now at the height of his prosperity. At more than 60 years of age he refused his labours, and completed his work on the law of nature.
nature and nations, which was written in Latin, and extended to eight volumes 410. He also wrote prefaces to the works of others, and particularly one to Soffmilch's work on population. Notwithstanding his great celebrity, perhaps on this account, he had many and powerful enemies. Leibnitz, Maupretius, and Voltaire, were of this number; and with respect to the latter, we may observe, that both in his writings and in his conversation with the king, he contributed in no small degree to lessen the veneration which Frederick II. entertained for him. In 1752 he was made a member of the Institute at Bologna; but he did not long survive this honour, as he died in the month of April 1754, in the 76th year of his age. He left one son, who inherited a considerable estate which he had purchased.

The adversaries of Wolf attacked not only the principles of his philosophy, but his method and his style. His Latin, it must be acknowledged, was not elegant; but his German has been commended and imitated; and he is said to have improved his native tongue both in precision and energy. With regard to his general disposition and demeanour, he is said to have united a great degree of complaisance and affability, with irreproachable morals and exemplary vanity, which he was not able to conceal. He did not hesitate to extoll himself and his own merits publicly and without reserve, and even to exhibit them in emblematical devices on the titles of his books. Brucker sums up the character of Wolf as a writer in the following concise manner: — "He possessed a clear and methodical understanding, which by long exercice in mathematical investigations was particularly fitted for the employment of digelling the several branches of knowledge into regular systems; and his fertile powers of invention enabled him to enrich almost every field of science in which he laboured, with some new addition. The lucid order which appears in all his writings enables his reader to follow his conceptions with ease and certainty through the long and train of reasoning. But the close connection of the several parts of his works, together with the vast variety and extent of the subjects on which he treats, renders it impracticable to give a summary of his doctrines." Brucker's Philosophy by Enfield, vol. ii. Preface to M. de Vattel's Law of Nations. See Leibnizian Philosophy.

Wolf, Jerome, a German philosopher, was born in the county of Oettingen, in the year 1516, and instructed in the elementary parts of education at a college established by the senate of Nuremberg. But his studies were interrupted by an appointment in the service of Julius, the chancellor of Count Von Oettingen. This interruption, however, contributed to allay the severity of his countenance and manner, and to mollify the moroseness of his temper; whilst these unamiable qualities were amply counterbalanced by probity, diligence, and modesty, which engaged the confidence and esteem of his employer. His habitual disposition again returned, and he resumed the study of poetry, and of the ancient Greek writers, against the remonstrances of the chancellor, who recommended attention to jurisprudence and public business, as the most effectual means of acquiring both honour and competence. Remonstrances were ineffectual, and he persisted in pursuining a course which cherishe his morbid melancholy and disquieting irritability. Still devoted to his literary pursuits, he was fortunate in gaining the patronage of John James Fugger; and in being afterwards advanced to the post of the director of the college of Augsburg, and that of librarian to this institution. In this situation he remained till his death, which happened in the month of October 1580. Wolf was particularly distinguished as a laborious translator, in which literary department he gained the commendation of Huet; though Henry Stephen censures his performances. When the edition of the Annals of Zonaras, published by Wolf at Basle in 1557, became rare, a new one, with notes by Du Cange, was printed at the Louvre in Paris in 1687. Wolf's translation of Demosthenes was first printed at Basle by Opinius; and being much approved, it passed through two other editions. After being revised by the translator, Epitocipus printed it at Basle in 1752, with the orations of Athines, the commentaries of Upian, and the notes of Wolhus. His other works, which were numerous, almost wholly related to Greek and Latin authors. Eloges par Forney et Tellier.

Wolf, John Christopher, a German Lutheran divine and eminent scholar, was born in 1613, at Wernigerode, and removing in 1605 to Hamburgh, was educated under the protection of the celebrated Fabricius, by whom he was employed, under the age of 20 years, in making a catalogue of all the writers quoted in Eulaliius's Commentary on Homer, afterwards inferted by Fabricius in his "Bibliothea Graeca." Having prosecuted his studies at Wittenberg, and graduated master of arts, he became, in 1706, adjunct of the philosophical faculty. Upon his return to Hamburgh, he undertook a tour in 1708 through Holland to England, and for some time resided at Oxford for the use of the Bodleian library. His next migration to Denmark led, in 1710, to the appointment of extraordinary professor of philosophy at Wittenberg, where his lectures collected a great number of pupils. Although he was here advanced to the chair of theology, he removed in 1712 to Hamburgh, and was appointed professor of the oriental languages in the Gymnasium, and in 1715 promoted to be rector of that institution. He was likewise a preacher-extraordinary at the cathedral, and became pastor of the church of St. Catharine; and soon after a member of the Academy of Sciences at Berlin. He commenced his literary contributions to the "Acta Eruditorum" in 1708; and he collected from various repositories an astonishing number of rabbinical and oriental books and MSS.; which library he bequeathed to the library at Hamburgh, where he died in June 1739. Of his numerous works, we shall here enumerate his "Bibliothea Hebraea," in 4 vols. fol.; "Historia Lexicorum Hebraicorum;" "Primitiae Hebræorum," five Oratio de Precocibus eruditis, et Ordinationem bine Deceffitate et Utilitate declamanti;" "Histo- ria Homologorum;" "Differtatio de Athenis falto fuf- pettis;" "Cura philologico et criticae in Novum Tef- tamentum," 4 vols. 4to. He was also the editor of several learned works. Gen. Biog.

Wolf. There are biographical articles for five German musicians of that name in Gerber's Continuation of Walther's Musical Lexicon.

Firß, Michael Christian Wolf, organist and music director in St. Mary's church at Stettin, born 1709, and who died in 1789, after publishing the following works: "Six Duets for two German Flutes at Berlin;" "Six Harpschord Sonatas," Stettin, 1776; "Songs with a Harpschord or Harp Accompaniment," Ebdem, 1777; "Exercises for the Organ in Choral Music;" and having in MS. a Psalm for Four Voices, with an Accompaniment for the Organ, and many other pieces for the church and chamber.

II. Erßl Friedrich Wolf, brother to the preceding master, late organist at Cologne, who died in 1772. He had been two years under the chapel-master Stölzel, for composition; and under the concert-master Hulin, at Gotha, for the violin. But at nine years old he had previously studied the scores of great masters, and the Gradus ad Parnassum.
of Fouche, so that early in life he became a great extempore player on the organ.

Of these two brothers we have never heard or seen the productions; but of

Ernst William Wolf, born at a village near Gotha, in 1735, chapel-murder at Weimar, we have seen and admired many of the works.

Wolf, in Astronomy. See Lupus.

Wolf, Lupus, in Zoology, the canis lupus of Linnaeus, a beast of prey of the dog kind, with the tail bending inwards, rather long and bulky, and the largest and fiercest of that race of animals. It is extremely like the domestic dog in shape, and if the head, which is long, with a pointed nose, did not differ a little in figure, the upper part of the face being broader, one would be apt to declare it the very fame animal. It is distinguished also by superior fize, stronger limbs, and more muscular body. It has a very fierce look about the face; its eyes are more obliquely placed than those of the dog, and are more glaring and savage; its jaws are much stronger; and its teeth, which are large and sharp, and the opening of its mouth, which is shorter in proportion than that of the dog, fierce and frightful. The ancients had an opinion, that the neck of the wolf was all of one solid bone; but, on the contrary, this creature is able to turn and twist it about better than the dog kind.

The wolf, as well as all the other beasts of prey, can endure hunger a long time, though very voracious when it meets with food. The wolf differs from the dog in its note, for instead of the barking of the dog this creature only howls; his ears, which stand erect, and his tail, make him also greatly resemble the fox.

The hair of the wolf is long; the legs are long; the head and neck cinerous: and the body generally pale grey, tinged with yellow; sometimes found white; in Canada sometimes black; and taller than a large grey-hound.

The wolf inhabits the continents of Europe, Asia, Africa, and America.

How numerous these animals were formerly in Britain we may infer from the laws of king Edgar, who attempted to extirpate them by committing the punishments for certain crimes into the acceptance of a number of wolves’ tongues from each criminal; in Wales by converting the tax of gold and silver into an annual tribute of three hundred wolves’ heads. In succeeding times their destruction was promoted by certain rewards; and some lands were held on condition of destroying the wolves which infested those parts of the kingdom.

In 1281, these animals infested several of the English counties; but after that period, our records make no mention of them. The last wolf known in Scotland was killed in 1689, and in Ireland one was killed in 1710.

The wolves of North America are the smallest; and it is said, that from those proceeded the dogs which were found there by the Europeans on their first arrival: when reclaimed, they are the dogs of the natives. In the less inhabited parts of the country, they gather in large droves, and hunt the deer and other animals like hounds with hideous howlings, and it is affirmed that they will attack even the buffalo. In the inhabited parts, they are become rare. In some parts of Europe their number has somewhat increased; e.g. in Sweden they were rare till about the year 1720. The Swedes destroy them by stuffing the carcass of a sheep or other animal with a species of lichen or tree-moss, (lichen vulpinus,) which is considered as a certain poison to the wolf, and also, as the name imports, to the fox. This is said to be mixed with pounded glass, which is probably more destructive than the lichen. The wolves of Senegal are the largest and fiercest; and they prey in company with the lion. Those of the Cape are grey striped black; others are black.

Wolves are cruel, but cowardly animals; they fly from man, except when impelled by hunger; in which case, they prowl by night in great droves through villages, and destroy any persons they meet; and having once got the taste of human blood, give it the preference. In hard weather wolves assemble in large troops, and join in dreadful howlings. They have a fine scent, and hunt by the nose: between them and the dogs a mutual enmity subsists. This animal has a very strong carnivorous appetite; and yet crafty, strong, and nimble as he is, and in every respect capable of feizing his prey, he often dies of hunger. Being driven into the forest, he finds only a few species of wild animals, who save themselves by flight, so that he perishes with want. Although he is naturally timid and dairily, he braves danger, when pressed with famine, and attacks those animals that are under the protection of man, and carries away lambs, small dogs, and kids, returning often to the charge, until being wounded by his pursuers, he retires to his den in the day, but inflicts forth in the night to his ferocious and destructive ravages. When his hunger is extreme, he attacks women and children, and sometimes darts with savage violence upon men, till at length he falls a sacrifice to his own rage. We have occasional accounts of the terror which this animal has excited, and of the destruction which he has committed among women and children in France. To such a degree did his ravages excite terror in 1764, that prayers are said to have been offered for his destruction.

Wolves, in the northern parts of the world, sometimes get on the ice of the sea, in order to prey on young fœls, which they seize when asleep; but sometimes the ice detached from the shore carries them to a great distance from the land, and large districts have thus been cleared of these pernicious animals, which have been heard howling in a dreadful manner far in the sea.

The wolf is sometimes affected with madness, accompanied with symptoms similar to that of dogs; and this disease happens to them in the depth of winter, and therefore, as Mr. Pennant observes, cannot be attributed to the rage of the dog-days. The time of gestation in the wolf is, according to Buffon, about three months and a half; and the young whelps are found from the end of April to the beginning of July; and this difference in the time of gestation, being in the wolf about one hundred days, and in the dog only sixty, he considers as a proof of the real difference between the two species.

Although the wolf seems to be naturally savage, he is capable, when taken young, of being tamed, and of being wholly divested of the ferocious character of his species. Ray. Pennant. Shaw.

Wolf, Golden. See Jackal and Auresus.

Wolf, Marine. See Hyena.

Wolf, Mexican, Canis mexicanus, with deftined tail and ah-coloured body, variegated with dusky bands and fulvous spots, a species that inhabits the hot parts of Mexico, agreeing in its manners with the European wolf. Its head, jaws, and teeth, are large; in the upper lips are strong bristles bent backwards, of a grey and white colour; the ears are large, erect, and cinereous, and the space between them marked with broad tawny spots; the head ah-coloured, crossed with dusky stripes; the neck fat and thick, and marked with a tawny stroke; on the breast is another of the same kind; the body is ah-coloured spotted with black, and the sides striped with the same colour; the belly
belly cincerea, the tail long, of the same colour, tinged in the middle with tawny; the legs and feet striped with black and ash-colour. This wolf is sometimes found white. Pennant.

Wolf, Black, Canis Lycaon, with straight tail, is considered by Buffon and others as a variety of the common wolf, and confounded by Schreber and Gmelin with the black fox; but regarded as a distinct species. It is found both in Europe and America, and in some parts of Asia. In America it is chiefly found in Canada, and in Europe in the more northern regions. Shaw.

Wolf, in the History of Insects, the name of a small white worm or maggot, which infests granaries, and does great damage there.

It is in this state of the worm that it does the mischief; but this is not its perfect form, for it is afterwards transformed into a small moth, with white wings spotted with black.

This little maggot has five legs, and as it creeps along, it sheds from its mouth an extremely fine thread or web, by which it fastens itself to every thing it touches, so that it cannot fall. Its mouth is furnished with a pair of reddish forceps, or biting instruments, by means of which it gnaws its way not only into wheat and other grain, but perforates even beams of wood, boxes, books, and every thing it meets with.

Towards the end of summer these pernicious insects may be seen crawling up the walls of corn-chambers, infested with them in great numbers; they are then searching a proper place where they may abide in safety during their auralia state; for when the time of their undergoing this change approaches, they forsake their food, and the little cells they had formed of hollowed grains of corn clotted together, by means of the web coming from their mouths. They now wander about till they find some wood, or other substance into which they gnaw holes with their fangs, capable of concealing them; and there enveloping themselves in a covering of their own spinning, they soon become a dark-coloured sort of auralia. They remain in this state all the winter; but in April or May they come forth in their moth-shape, and are then seen in vast numbers, taking short flights, and creeping up the walls. In this state they eat nothing; but they soon copulate and lay eggs, which are in the shape of a hen's egg, but not larger than a grain of sand. Each female lays fifty or seventy eggs, which the deposits in the little wrinkles of the grains of corn, where in about sixteen days they hatch, and the minute maggots immediately perforate the grain, and eat out all its substance, and with the threads which come from their mouths cement other grains to it, which they, in the same manner, scoop out and destroy.

The watchful observer has two opportunities of destroying these devourers from among his corn. One is, when they forsake their food, and ascend the walls, which they will sometimes almoast cover. The other, when they appear in the moth-stage. At both these times they may be crushed to death against the walls in great numbers, by clapping facks upon them; but they may be exterminated more ef- fectually by closing up all the windows and doors, and burning brimstone on a pan of charcoal, letting the room be full of the fumes of it for twenty-four hours. This certainly destroys the animals, and does no sort of injury to the grain, not communicating the flighted scent to it. Baker's Microphi. p. 222.

Wolf's Bane, in Botany. Seeaconium.

Wolf's Bane, Winter's, a species of hellebore; which see.

WOLF-FISB. See Lupus Marinus.

WOLF'S GRAPES. See LycoSTAPHYLE.

WOLF-Net, a term used by the sportsmen for a kind of net used in fishing, which takes great numbers, and has its name from the destruction it causes.

It is used both in rivers and ponds, and is of the nature of the rattle, excepting only the wanting of the four wings. The trunk or cover consists of seven feet, besides the two gullets. It is supported by hoops, and is to be placed in some part where there is an abundance of fedges, rushes, and water-grafs. There is to be a place made for the net here, by the use of a paring-knife, cutting away all the weeds and other matter, for the space that will contain it; and when the net is placed, there are to be two alleys cut or cleared in the same manner, one on each side of the net, that the fish may be invited into them, and by them into the net. There must be some lines or leaden weights used to sink the net, and a long pole fastened to the upper part of the mouth of it, by means of which, when it is well filled with fish, it may be lifted up and taken to the shore.

Wolf's Peach. See Lyceopersicon.

Wolf, War, an ancient military machine, differently des- cribed by different writers. Procopius makes it a kind of portcullis, or rather a barrow for defending a gate. Matthew of Westminster, and Camden, describe it as a machine for throwing stones. "At the gates," says Procopius, (Hist. of the Gothic Wars, book i.) "they let up wolves in the following manner:—They erected two beams from the ground reaching to the battlements, and laid checkerwise pieces of wortimer timber, some upright and some crofs; they jointed them so that the mortising holes met one another; and before each joint stuck out a pointed piece of wood, like a thick spar, and fastening the crofs timbers to another beam, which from the top reached half-way down: they laid the beams flat along upon the gates, and when an enemy approached, men above laid hold of the higher ends of the beams, and thrust them down, which falling suddenly among the assailants, with the wooden points flicking out, killed all upon whom they descended." Probably there was a chain or cord to draw back the machine after it had produced its effect.

The war-wolf, for throwing stones, is described by Matthew of Westminster, ann. 1304; by Camden, in his Remains, to which we refer; and also to Grose's Mil. Antiq. vol. i. p. 383.

Wolf Island, in Geography, an island in the North Atlantic ocean, near the east coast of Labrador. N. lat. °53° 55'. W. long. 5° 40'.—Also, an island at the north-east end of lake Ontario. N. lat. 4° 54'. W. long. 7° 50'.—Also, an island in the gulf of St. Lawrence, near the south coast of Labrador. N. lat. 5° 1'. W. long. 6° 55'.—Also, a small island in the Atlantic Ocean, near the coast of Georgia. N. lat. 31° 19'. W. long. 81° 30'.—Wolf River, or Chickaw Bluff, a river of Georgia, which runs into the Mississipi, N. lat. 34° 45'. W. long. 90° 42'.

Wolf Rock, a very low, flat, rocky islet, in the North Pacific ocean, surrounded by rocks and breakers, which extend some distance from it; 10 miles from the southern coast of the Prince of Wales's Archipelago. N. lat. °55° 1'. W. long. 226° 42'.—Also, a rock near the coast of Labrador, and not far from the island called Wolf Island.—Also, a rock at the entrance of the English channel; 10 miles S. of Land's-End. N. lat. 49° 58'. W. long. 5° 45'.

WOLFBOROUGH, a township of New Hamp-
thire, in the county of Strafford, on the Winnipiccoogee lake, containing 1376 inhabitants; 35 miles N.W. of Durham.

WOLFDORF, a town of Bohemia, in the circle of Letimeritz; 7 miles N. of Kaminitz.

WOLFFENBUTTEL, a principality which lately constituted a part of the duchy of Brunswick, divided into two parts by the principality of Halberstadt, and the diocese of Hildesheim. The north part is surrounded on the north by the principality of Luneburg and the marquisate of Brandenburg, on the east by the duchy of Magdeburg, on the south by the principality of Halberstadt, and on the west by the diocese of Hildesheim. The south part is bounded on the north by the bishopric of Hildesheim and the principality of Calenberg, on the east by the diocese of Hildesheim and the Harz forest, on the south by the principality of Grubenhagen and Calenberg, and on the west by the territories of the abbey of Corvey and Calenberg. The eastern half contains under it a part of the Harz forest, the mines and salt-works which the prince held in common with the elector of Brunswick Luneburg. In the western half of this southern part is a part of the forest of Sollingen, consisting of oak and beech, with a chain of mountains covered with woods. Thus the southern part of the principality consists chiefly of hills and woods, with little arable land; but, on the other hand, has a great variety of timber, iron, and glas-house, the manufactures of which are greatly admired, particularly those of looking-glasses, with a fine porcelain manufacture, and the very rich mines and salt-works in the Harz forest. The north part of the principality is more level, and produces abundance of grain, flax, and hemp, together with various kinds of pulse and fruit. Their grazing here turns to very good account, besides which it has a salt-works. The culture of silk is now followed, and premiums are assigned by the prince for the encouragement of it. The Weiler, the Leine, the Inner See, and the Oker, are the principal rivers. In this principality are 18 towns, 386 villages, and 17 fees and consuls. The established religion here is Lutheranism. The country of Brunswick was anciently under lords of its own, who possessed it as their absolute and hereditary property, and derived its lineage from Ludolphus, duke of Saxony, and, consequently, by his grandmother Hafala, or Cigela, from duke Wittikind, whole daughter the was. From King Henry I., grandson to Ludolphus, was descended his son Henry, duke of Bavaria, among whose issue was Count Bruno, on whom the emperor Otto conferred a tract of land in Saxony, near Brunswick, namely, Melverode and Hohenwart. Count Bruno, his son, enlarged Brunswick; and his son, Count Ludolphus, on the demesne of the emperor Henry II., was the first that obtained the full sovereignty over Brunswick and Thuringia, and died in 1038. His son Egbert I. became margrave of Thuringia and Meissen; and his son Egbert II. like-wise attained to those dignities. This last prince being killed in battle, in 1091, his father Gertrude succeeded to the country of Brunswick, which country she brought to her second husband, Henry the Fat, count of Nordheim; and by their daughter Rickenza it came to her husband Lothario, count of Supplinburg, afterwards emperor. By his daughter Gertrude it descended to her husband, Henry the Magno-nimous, duke of Bavaria and Saxony, and thus to the house of Wolpho. The principality of Wolftenbuttel was possessed of a vote among the princes, both in the college of the princes of the empire, and likewise in the diet of Lower Saxony; in each of which, by virtue of an agreement concluded in 1706, when the seniority lies in the house of Brunswick Wolftenbuttel, it precedes those of the elector of Brunswick and Luneburg, for Zelle, Grubenhan, and Calenberg, but otherwise comes after them; farther, the house of Wolftenbuttel, when senior, obtained the joint direction of the circle of Lower Saxony. In 1807, this principality was annexed to Welfphalia.

WOLFSKINN, a city of Welsphalia, and capital of a principality of the same name, situated in a marshy soil, on the Ocker; it is well built and fortified. In it is a chateau, a long time the residence of the dukes, in which is a noble library containing 120,000 volumes of printed books and manuscripts. The principal church contains the sepulchral monument of the dukes. Wolftenbuttel very probably owes its name to the first builder of the palace, called Wolf, or Wolfr, or Wolfhard; 24 miles E. of Hildesheim. N. lat. 52° 10'. E. long. 10° 40'.

WOLFFERSDORF, a town of Saxony, in the circle of Neuffadt; 4 miles S.W. of Weyda.—Alto, a town of Saxony, in the circle of Neuffadt; 6 miles E.N.E. of Weyda.

WOLFFERSDYCK, a small island of Zealand, between North and South Beveland.

WOLFSHEIM, a town of Germany, in the principality of Solms Brunsfeld; 12 miles S.S.E. of Wetzelar.

WOLFERSTORFF, a town of Austria; 2 miles S.E. of Laab.

WOLFERZHAUSEN, a town of Bavaria; 12 miles N.E. of Weilheim.

WOLFESHEAD, or WULFERSHEAD, SAXON, wulfer-heel, compounded of wulf, wulf, and healf, head, caput Lupinum, denoted the condition of those outlawed for criminal matters in the Saxon time, and not yielding themselves to justice. For if they could have been taken alive, they must have been brought to the king; and if they, for fear of being apprehended, did defend themselves, they might be slain, and their heads brought to the king; for their head was no more to be accounted of than a wolf's head. LL. Edw. in Lanc. fol. 127. and Bract. lib. iii. tract. 2. c. 11. See CAPUT Lupinum, and Outlawry.

WOLFSATAAL, in Geography, a town of Austria; 2 miles E. of Hainburg.

WOLFFACH, a town of Germany, in the lordship of Furthenberg; 4 miles S.S.E. of Hazlach. N. lat. 48° 14'. E. long. 8° 10'.

WOLFFBERG, a town of Austria; 5 miles N.W. of Schwanaufedt.

WOLFFBERG, or WOLFECK, a chateau and village of Germany, which gives the title of count to a noble family, divided into several branches, viz. Wolfberg Zeil, Wolfberg Wurzach, Wolfberg Wolfsberg, and Wolfberg Waldsee; 10 miles W. of Leutkirch.

WOLFFEN, a town of Saxony; 3 miles N.W. of Bitterfeld.

WOLFFPASSING, a town of Austria; 9 miles S. of Ips.

WOLFFSHAGEN, a town of Brandenburg, in the Mark of Pregnitz; 6 miles W. of Prizwalk.

WOLFGANG, a town of Germany, in the county of Henneberg, on an island in a lake; 7 miles S.W. of Meiningen.

WOLFGANG, St. a town of Austria; 3 miles S.S.W. of Aigen.—Alto, a town of Austria; 1 mile N. of Kirchschlag.—Alto, a town of Austria, on a lake, called the Abernies, and St. Wolfgang's lake; 54 miles S.S.W. of Lintz.
Linz. — Also, a town of Switzerland, in the canton of Zug; 4 miles W. of Zug.

WOLFGAST, or Wolgast, a town of Anterior Pomerania, on the Pea, about three miles from the Baltic, with about 3500 inhabitants. It was anciently a considerable fortress, and residence of the dukes; 30 miles S.E. of Stralsund. N. lat. 54° 2'. E. long. 13° 45'.

WOLFIA, in Botany, a genus of Schreber's, feems by its orthography intended to commemorate Dr. de Wolf, of Danzig, of whose whimsical attempt in the Nomenclature of plants, we have given a sufficient account at the conclusion of that article. This writer, to whom the praise of labour and originality cannot be denied, and whose index, entitled Concordantia Botanica, is truly valuable, died in 1784, aged 60. There have been several German naturalists and physicians of the name of Wolf, but none eminent in botanical studies.—Schreb. Gen. 891.—Clafs and order, Orchestria Monogynia. Nat. Ord. Tribulata, Linnae. Sapindi, Jull.

Gen. Ch. Cal. Perianth inferior, of one leaf, coloured: tube very short, somewhat dilated at the base, permanently: limb in five deep, linear, obtuse, moderately spreading segments. Cor. none. Nectary of eight linear, obtuse, villous, upright scales, one-third the length of the calyx, and inserted into it at the base of the limb. Stem. Filaments eight, awl-shaped, erect, the length of the calyx, into which they are inserted alternately with the scales of the nectary, in the same row; anthers ovate, attached by the back, erect, directed inwards. Pfl. German superior, oblong, ending in a cylindrical upright style, the height of the filaments; stigma oblong, downy, unilaterial. Peric. Berry? ovate, of one cell, somewhat flat-topped, with three keels surrounding its fummit. Seeds three, nearly ovate, oblong, externally gibbous, contracted below the middle, abrupt at the base, enclosed in a tunic.

Obf. There appear to be several seeds, some of which prove abortive.

We have tried in vain to guess any thing more respecting this genus than its natural order, of which there can be scarcely a doubt. No author has adopted Wofia. There are, in its characters, some indications of Jambolifera, Willd. Sp. Pl. v. 2. 326. Gymnosma, Gertn. t. 58, (which ought to have found a place in our 18th volume; see Calyptranthes also); and a botanist who compares Schreber's description, literally translated above, with Jambolifera pendulata, will find several coincidences, which, allowing for one or two eafy misconceptions, might almost persuade us he had defribed that plant; but still there are infeivable difficulties. Schreber's index directs us at the word Pituma, to the fame number as his Wolfia, 1749. But no such synonyn occurs there, nor, as far as we can find, elsewhere in his book. Pet. tumo, Rheede. Hort. Mal. v. 9. t. 45, is a Juficia, and can have no connection with the present plant. See other obscure genera, thus circunlanced, at the articles Meyeria, Wheelera, Spinaria, and Xystris.

WOLF-MONETH, a name given by our Saxony ancestors to the month of January, on account of the ravages committed by the wolves in that month through the severity of the cold.

WOLFRAM, in Mineralogy, an ore of tungsten. (See Tungsten.) The colour of Wolfram is generally a brownish or greyish-black; it gives a reddish-brown streak when cut with the point of a knife, to which it yields readily, a property characteristic of this mineral. It occours both massive and crystallized, and in concentric lamellar concretions. The form of the crystal is a flat rectangular prism; the lateral planes are generally streaked longitudinally. The structure is lamellar, with a very distinct cleavage in one direction, and an indistinct cleavage at right angles to the former. The luster of the principal cleavage is pellucid or shining, and is metallic; that of the indistinct cleavage is glassy. The specific gravity of Wolfram is from 7.1 to 7.3. Before the blow-pipe it decrepitates, and melts with difficulty into a black flag.

The constituent parts of Wolfram, as given by Vaucoulemont, are,

<table>
<thead>
<tr>
<th>Mineral</th>
<th>Name</th>
<th>Specific Gravity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tungsten acid</td>
<td>67</td>
<td></td>
</tr>
<tr>
<td>Oxyd of iron</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>Oxyd of manganese</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Silex</td>
<td>1.50</td>
<td></td>
</tr>
</tbody>
</table>

Wolfram most frequently occurs in veins with tin-flue, but may be distinguished from it by its greater degree of softness, and the reddish streak which it yields to the knife. It is common in many of the mines of Cornwall, and in those of Saxony, and of Zinnweld and Schlackenwald, in Bohemia. This mineral has not hitherto been applied to any useful purpoBe in the arts. It was originally mislaken for antimony, which by the alchemists was called the wolf, because it appeared to destroy the bafier metals in the proeesses of refining gold.

WOLFRAMITZ, in Geography, a town of Moravia, in the circle of Znaym; 20 miles N.E. of Znaym.

WOLFSBAHCH, a river of Silefia, which runs into the Rhine, near Loewenberg.

WOLFSBERG, a town of the duchy of Carinthia, on the river Levent, with a citadel; 10 miles N.N.W. of Lavamont.

WOLFSBACH, a town of Prussia, in the province of Ermeland; 18 miles W.S.W. of Hellisberg.—Alto, a town of Saxony, in the circle of Neukland; 5 miles S.W. of Weyda.

WOLFHAGEN, a town of the principality of Hesse Cassel, on the Erpe; 15 miles W. of Cassel. N. lat. 51° 15'. E. long. 7° 10'.

WOLFPON, a small island in the gulf of Fineland. N. lat. 50° 22'. E. long. 24° 41'.

WOLFSCHACH, a town of Austria; 8 miles E. of Steyr.

WOLFSTEIN, a town of France, in the department of Mont Tonnerre; 43 miles W.N.W. of Manheim.

WOLHUSEN IN MARKT, a town of Switzerland, in the canton of Luzern; 7 miles W.S.W. of Luzerne.

WOLIN, or Wolinsky, a town of Bohemia, in the circle of Prachatitz; 8 miles N.N.W. of Prachatitz. N. lat. 49° 50'. E. long. 13° 45'.

Wolin, a town of Brandenburg, in the Middle Mark; 10 miles S.S.W. of Brandenburg.

WOLKART, a mountain of Carinthia; 8 miles N.E. of Militatt.

WOLKENMARCK. See WOLKENMARK.

WOLKENSTEIN, a town of Saxony, in the circle of Erzgebier, with a citadel, situated on a rock, near the Zincha. About half a league from the town are some warm medicinal baths; 13 miles S.S.E. of Chemnitz. N. lat. 50° 36'. E. long. 12° 59'.—Alto, a town of the county of Tyrol; 3 miles W. of Lenzth.
WOLKOMYSK, a town of Lithuania, in the palatinate of Novogrod; 40 miles W.S.W. of Novogrodek.

WOLLACOMB BAY, a bay of England, on the west coast of Devonshire, situated to the north of Barnstaple bay.

WOLLAPALLAM, a town of Hindoostan; 10 miles E. of Coimbatore.

WOLLASTON, William, in Biography, an ethical writer, was born in 1659 at Cotton Clifton, in Staffordshire, and finished his education as a penonner of Sidney college, Cambridge. In 1681 he commenced M.A. and entered into deacon's orders. His first settlement was as an almoner in the free school at Birmingham, to which a small lecture ship was annexed; and about four years afterwards he was advanced from this laborious situation to the office of second master in the same school. In 1698 a relation died, whose decease put him in possession of a considerable landed estate, upon which he removed to London, and marrying a lady of considerable fortune, he resided in Charterhouse-square. Dissipating all thoughts of church preferment, he devoted himself to the retirement of private life and to a course of study, comprehending the learned languages, together with Hebrew and Arabic. The first publication which flowed from the press was a poem on Ecclesiastes, which he would afterwards have suppressed, from a conviction that his talents were not adapted to poetry. In the progress of his life and literary pursuits, he was so much amused by composition that he wrote many treatises on various subjects, both in Latin and English, which he committed to the flames. Of the well-known work which has perpetuated his name, and which is intituled "The Religion of Nature delineated," he printed a few copies to be distributed among his friends in 1722, but his declining health prevented his completing his original design. However, in 1723 he was prevailed upon to revise what he had printed for publication, and it accordingly appeared in 1724, in which year he died, at the age of 65, leaving a large family, and having loft his wife, to whom he was affectionately attached, about four years before. In his private character he is said to have exemplified the virtues which his work incalculated. The system which he developed, and which founded morality upon "truth," excited much attention, and his book, though not written in a popular manner, passed through seven editions to the year 1750. The last of these editions includes an appendix, consisting of a translation of the Latin notes by Dr. J. Clarke, dean of Salisbury, undertaken at the particular request of queen Caroline, who was a great admirer of the work. Dr. Warburton, in his Lectures on Wollaston's theory in his Divine Legislation, honours the author by ranking him as "one of our most celebrated writers," and compliments him with having "demonstrated with greater clearness than any before him the natural essential difference of things;" and though modern systems have in a considerable degree antedated that of Mr. Wollaston, the author must always be regarded as a man of extensive learning and strong reasoning powers. Biog. Brit.

WOLLANDS, in Geography, a town of Germany, in the margrave of Anspach; 10 miles E. of Anspach.

WOLLANDS, a town of Austria; 5 miles W.N.W. of Neultatt.

WOLLANDS, a town of Brandenburg, in the Ucker Mark; 10 miles E.S.E. of Prenzlau.

WOLLANDS, a town of Anterior Pomerania, on the east coast of the island of the land, separated from the continent of Pomerania by the river Dorenow, over which is a bridge, at which all travellers pay a toll. In this town are a feat and
favour and confidence he conciliated by his blending amuse-
ment with business, in so much that he supplantcd the minis-
ters of the late king, and became himself uncontrolled minis-
ter. His preferments, civil and ecclesiastical, very speedily
succeeded one another, and even profusely accumulated.
He was introduced into the privy-council in 1510, made
reporter of the flar-chamber, register, and afterwards chanc-
eller of the garter; and advanced to the fees of Tournauy
and Lincoln in 1513, to that of York in 1514, and to the
dignity of cardinal in 1515. Thus promoted, his pride and love
of pomp kept pace with his elevation of rank. In his train of
servants, 800 in number, were many knights and gentlemen;
and the fees of noblemen acted occasionally as his domes-
ticial menials. His equipage and furniture were of the most costly
kind; but it is needful to multiply particulars. The most
pardonable, not to say laudable, display of his magnificence
was exhibited in his patronage of literary men and promo-
tion of literature, both by the exercise of private bounty
and the Establishment of public institutions. The pope
ominated him legate à latera, by which office he acquired
legal pre-eminence over the archbishop of Canterbury; and
in December 1515, he was elevated to the office of high-
chancellor. By the equity of his decisions in the exercise
of this office he gained great credit; but his conduct as le-
gate à latera was fo arbitrary and oppressive, as to produce
complaints against him to the king. Charles V. and Fre-
deric I. purchased his interest with Henry VIII. by pen-
sions, and he was also retained in the same way by the
pope. Charles flattered him with hopes of the papal
crown, and settled upon him the revenues of two bish-
ropies in Spain. Still infatiable in the pursuit of ecclesiasti-
cal preferments, he obtained the administration of the see
of Bath and Wells, and the temporalities of the abbey
of St. Alban’s, to which were afterwards added successively
the rich bishoprics of Durham and Winchester. His revenues,
thus amounting nearly to that of the crown, were expended
partly in the ostentation of pomp, and partly in laudable
munificence. He founded several lectures at Oxford for
liberal and useful studies, and at length erected in that uni-
versity the celebrated college of Christchurch. He also
established a collegiate school in his native town of Ipswich.
The palace which he built at Hampton Court he prefented,
in 1528, to the king, and he further ingratiated himself
with Henry by an arbitrary loan for the supply of his wants;
but by these measures he became more and more odious to
the nation. But his fall was approaching; and the first
step to it was the divorce of queen Catharine. This was fol-
lowed by the marriage of Henry with Ann Boleyn, whose
influence was employed in effecting his downfall. At
length the king, not without hesitation and reluctance, em-
ployed the dukes of Norfolk and Suffolk, in 1529, to re-
quire him to surrender the great seal, and to quit York-
place, a palace which he had built in London, and which
afterwards became a royal residence under the name of
Whitehall. His furniture and plate were seized for the
king’s use, and he was ordered to retire to Esher, a palace
which belonged to him as bishop of Winchester. These
measures overwhelmed the favourite, delirium of any inward
resources of magnanimity; and when he received a flight
token of the king’s favour in this state of mental depression,
he was transported with joy, dismounted on meeting the
messenger, and fell upon his knees in the dirt to receive the
expression of his master’s kindnecfs. Henry, however, was
capricious and inconstant; a cloud overspread this glem,
and Wolsey was ordered to be indicted in the star-cham-
ber, and abandoned by his sovereign to the rigour of
parliament. An accusation, consisting of 44 articles, was
exhibited against him by the house of lords; and in the
commons, he was fo ably defended by Thomas Cromwell,
who had been raised by the cardinal from a low condition to
a high station, that his enemies were defeated. They thus
changed their plan, and indicted him upon the statute of
provisors, which prohibited his procuring bulls from Rome,
and which he had violated by obtaining the legantine power;
and this was made the ground of a sentence, putting him
out of the king’s protection, forfeiting all his lands and
goods, and declaring him liable to imprisonment. When
these measures had induced him to resign the king York-
place with all its furniture, he obtained a full pardon for all
his past offences, and the restoratien of the revenues of
his archbishopric, with part of his goods. But fresh tokens
of royal displeasure awaited him. The earl of Northumber-
land was ordered to arrest him for high treason, and to con-
duct him to London for trial. In his way from York to
London, he was seized with a disorder which obliged him
to stop at Leicester, where he was hospitably received in the
abbey. His disorder in a few days terminated his life, in
the 6oth year of his age. Shortly before he expired he
closed a conversation with the confiablc of the Tower, which
related to the king, with this exclamation, “Had but I
served God as diligently as I have served the king, he would
not have given me over in my grey hairs!” Thus he sunk
to the grave as a victim to tyranny, but to a tyranny which
he had himself formed; exhibiting an instructive example
to all future ministers of the insecure possession of power and
wealth acquired by extortion and oppression, and of the
folly of placing confidence in princes embracing arbitrary
and despotic measures, and governed by caprice and per-

The magnificence of the cardinal’s chapel-establishment,
as described by Cavendish, his contemporary and domestic,
seems far to have surpassed that of the Roman pontiff
himself.

“First, he had there a dean, a great divine, and a man
of excellent learning; a sub-dean, a repeator of the quire,
a gospeller and epifullar; of singing priecls, ten, a matter
of the children. The seculars of the chapel, being finging-
men, twelve; singing-children, ten, with one servant to
wait upon them. In the veltry, a yeoman and two
grooms; over and beside other retainers that came thither
at principal feasts. And for the furniture of his chapel, it
pallished my weak capacity to declare the number of the
coftly ornaments and rich jewels that were occupied in the
fame. For I have seen in proceffion about the hall forty-
four rich coves, besides the rich candlesticks, and other
necafsary ornaments to the furniture of the fane.”

The earl of Northumberland, whose passion for Ann
Boleyn is supposed to have occasioned his disgrace at court,
seems to have been treated with great insolence and in-
dignity by the cardinal, who, by an extraordinary exten-
sion of power, demanded his choral books for the use of his
own chapel. Letters concerning this requisition are still
preserved in the family, in which the earl fays, “I do per-
ceyffy my lorde cardinals pleafures to have fuch books as
was in the chapell of my lat lorde and ftyther (wos refl
Jhui pardyn.) To the accomplifhment of which, as your
defyer, I am confiderable, notwithstanding there is no trull
to be able ons to fet up a chapell of my owne. I shall with all
fudel fend up the boks unto my lorde’s graces, as to fay iiij
Antiffaror (Antiphoners), fuch as I thinke when not feen a
gett wyl—v Grelts (Graduals) an Orderly (Ordinal)—
a Manual—viii Prafflifioners (Proceffionals).” Northum-
berland Household Book.

WOLINGHAM, in Geography, an irregular town in
the
the county of Durham, England, is pleasantly situated in the vale of the Wear, on a point of land formed by the confluence of that river and the Weferow. The church is situated at the north side of the town on rising ground, but possesses nothing worthy of remark. Near it are some remains of a considerable building, inclosed with a deep moat, suppos'd by some writers to have been part of a monastery, which was founded by Henry de Pudley; but Hutchin, in his History of Durham, refers them to the ancient manor-house of the bishop's, which is mentioned in Hatfield's Survey. The inhabitants of this parish, according to the returns of 1811, are 283, and the houses 399. The views down the Wear from the hill above Wolfgamsham include a very extensive and beautifully diversified country. Between this town and Stanhope, the commencement of the lead district is everywhere intimated by large parcels of lead lying near the sides of the road, and from the blue or white vapours arising from the smelting mills in Bollihope. On Bollihope common, in 1749, was found a Roman altar with an inscription. This town is 6 miles S.E. by S. from Stanhope, and 259 N.W. from London. Here is a market held on Tuesday, and a fair on the 18th of May. The petty feftions are held here. The parish, which is large, confines of Bradley, Hilton-park, Thornley, Wolfgamsham town quarter, East side quarter, Park quarter, and South side quarter.—Beauties of England, Durham, vol. iv.; by J. Britton and E. W. Brayley.

WOLTA, a town of Bohemia, in the circle of Konigratz; 2 miles N. of Trauttenburg.

WOLTERN, a town of Germany, in the county of Verden; 30 miles E. of Rotenburg.

WOLTERSDOF, a town of Saxony; 2 miles S.W. of Zahna.

WOLTIN, 2 miles N. of Hinder Pomerania; 12 miles S.W. of Stargard.

WOLTFORF, a town of Auefia; 2 miles N.W. of Weikerfard.

WOLVERENE. See GLUTON.

WOLVERHAMPTON, formerly HAMPTON, in Geograpy, an important market-town in the hundred of N. Stafford, and county of Stafford, England, is particularly noted for its extensive manufactures of locks, keys, and other articles of ironmongery. It is situated on a rising ground 16 miles S. from Stafford, 14 S.W. from Lichfield, 13 N.W. from Birmingham, and 130 in the same direction from London. Wolverhampton is of ancient date, for as early as 966 a monastery was founded there by Wulfuna, from whom the town received the first member of its name. The institution, consisting of a dean and secular canons, was about the year 1200 transferred by the dean, Peter of Blois, to the archbishop of Canterbury, to convert it into an abbey for Cistercian monks; but this design seems not to have been executed, for the seculars appear to have been not long after in possession of the establishment. The church, which was considered as one of the king's free chapels, was by Edward IV. annexed to the deanery of Windsor; but in the seventh year of Edward VI. a grant of the college of Wolverhampton and seven prebends was made to John, duke of Northumberland. Coming again to the crown by his attainder, queen Mary reinstated the dean and prebendaries, and endowed them with all the lands, &c. which formerly belonged to the institution, then valued at the yearly rent of £36. 13s. 4d. On a question arising concerning these possessions, the grants of Mary were confirmed by James I., who appointed the celebrated Marc-Antonio de Dominis, who had been archbishop of Spalatro in Dalmatia, to be dean of Windsor, and dean and first prebendary of Wolverhampton:

those deaneries continue to be united, but the colleges are separate.

Wolverhampton is well built, and considered as fabulous, notwithstanding it is in the vicinity of many coal-mines. The parish is of great extent, being nearly 30 miles in circuit, and comprehends, besides the town, seventeen considerable townships, or villages, among which are, Billiton, Featherstone, Hattherton, Hilton, and Kinvalton. According to the returns to parliament in 1811, the houses in the whole parish were 2936, and the inhabitants 14,836. A market is held on Wednesday, and a fair on the 10th of July. The skill and ingenuity of the lock-smiths of the town and the environs, (for many of the farmers themselves are concerned in the business,) and the trade carried on in these and similar articles of iron manufacture, are unparalleled in England: the trade is particularly promoted by the Staffordshire and Worcestershire grand trunk, and the Birmingham canals, which unite about a mile to the N. of the town. The town is governed by two constables, and in it are held the petty seftions for the N. and S. divisions of Stafford hundred.

The collegiate church of St. Peter stands on an elevation on the E. side of the town, and consists of a lofty nave, with side-aisles and a chancel. From the centre of the building, which is of stone, rises a tower. The nave is separated from the aisles by five pointed arches, supported by octagonal pillars. Against one of the S. pillars is erected a very curious stone pulpit. The font, which is octagonal, and covered with sculptured figures, &c. appears to be very ancient. In the great chancel is a full-length statue, in brass, of the celebrated admiral Sir Richard Leveson, who had a command against the Spanish armada, under Sir Francis Drake. In the church-yard stands a round column twenty feet high, profusely but rudely carved in divisions, and the whole surmounted by a plain capital. It is evidently ancient, and may have supported a cross, or the figure of the patron-saint. The situation of Wulfuna's monastery is unknown; but in the S.W. corner of the burying-ground is a large room supported by groins, the walls of which are three yards in thickness. Beside St. Peter's, Wolverhampton possesses another church, dedicated to St. John, which was erected by subcription, and consecrated in 1761. Difficulties of various denominations abound in the parish of Wolverhampton, and comprehend more than one half of the inhabitants: chapels for their accommodation are consequently numerous. A free-school was founded here by Sir Stephen Jennings of Wolverhampton, who was lord-mayor of London in 1668; besides which, charity-schools are maintained for children of both sexes. Bilston, a large and populous village two miles S.E. from the town, is within the parish of Wolverhampton; but as to all parochial concerns it is a separate township. In 1811 Bilston contained 1862 houses, and the inhabitants amounted to 9646. Here is a parish-chapel, which is a neat modern structure; the living is a perpetual curacy within the exempt jurisdiction of the dean of Wolverhampton; but the nomination and presentation of the incumbent are vested in the inhabitants at large. Bilston contains likewise two dissenting meetings, and an excellent charity-school. The business of Bilston consists chiefly of japanned and enamelled goods. The vicinity abounds in coal, iron-stone, with numerous smelting-furnaces and forges, &c. in which the operations are performed by steam-engines. Bilston furnishes also a peculiar kind of sand of great use in casting metals. At Bradley, near Bilston, the subterraneous coal has been burning for several years past, and every attempt to extinguish it has hitherto proved fruitless, by which several
val acres of land have been rendered unproductive. The fire proceeds from a burning stratum of coal about four feet thick, and eight or ten yards deep, to which the air has free access; as the main bed of coal has been dug out from under it. In collecting the calcined substances for repairing the roads, sulphur and alum are frequently found. Tatenhill, a small village on a steep eminence two miles N. from Wolverhampton, was the scene of a severe battle between Edward the Elder and the Danes, in the beginning of the tenth century. In this place was founded, before the Norman Conquest, a college with a dean and five prebends, which sufficed till the general dismission by Henry VIII. The present church, or chapel, is apparently a part of that establishment. At Wrottesley, a village in the parish of Wolverhampton, extensive ancient remains have been discovered, supposed, by Dr. Plott, in his History of Staffordshire, to be vestiges of the old Theoten-hall of the Danes: but later antiquaries imagine these remains to belong to the Uriconium of Roman Britain. The parish of Wolverhampton, although varied with eminences, is in general level, and ornamented with a number of agreeable hamlets and country-seats.—History and Antiquities of Staffordshire, by the Rev. Stebbing Shaw, fol. Lond. 1798. Beauties of England and Wales, Staffordshire, 8vo. Lond. 1814.

WOLVES-TEETH, of a horse, are overgrown grinders, the points of which, being higher than the rest, prick the creature's tongue and gums in feeding, so as to hinder chewing of the meat. They are seldom met with in young horses; but if they be not daily worn by chewing, they will grow up even to pierce the roof of the mouth. There are usually two of these wolves-teeth, which are small, and grow in the upper-jaw, next to the great grinding-teeth: these are so tender and painful, that the horse cannot chew his meat, but is forced to let a great part of it fall out of his mouth, or swallow it half chewed. The remedy, in this case, is to tie up the horse's head to some part of the rafter, and open his mouth with a cord; then with an instrument like a carpenter's gauge, and a mallet, the teeth that are thus troublesome are to be knocked out, and the holes filled up with salt. If the upper-jaw teeth hang over those of the under-jaw, and by that means cut the mouth, the same instrument is to be used, and the teeth are to be pared shorter by little and little. When they are sufficiently pared down, they must be filed smooth, and the mouth washed with vinegar and salt, and the whole complaint will be thus removed.

WOLVES, Rout of. See ROUT.

WOLVES ISLANDS, in Geography, a cluster of small islands near the E. coast of Maine. N. lat. 45° 4'. W. long. 66° 50'.

WOLVEY, a village of England, in the county of Warwick. It was at this place that Edward IV. was purcased and taken prisoner by Richard Neville, earl of Warwick; 10 miles N.E. of Coventry.

WOLZ. See WELS.

WOMAN, FEMINA, Mulier, the female of man.

A woman, in England, as soon as she is married, with all her moveables, is wholly in potestate viri, or at the will and disposal of her husband. There are divers considerable things relating to women in the laws of England, which see under WIFE.

St. Augustine calls women the devotus sex; at least, this is the common opinion; though others rather think, that in the prayer usually attributed to that father, and still rehearsed in the Romish church to the Holy Virgin, the words

"intercede pro devote femine sex," are to be understood of women devoted or consecrated to God in religious houses; which had been sufficiently expressed by the words, "ora pro populo, interveni pro clero."

It is a popular tradition among the Mahometans, which obtains to this day, that women shall not enter paradise.

An anonymous author, about the close of the sixteenth century, published a little Latin dissertation, to prove that women are not men; that is, are not reasonable creatures: "Differatio perjculanda, qua anonymus probare nititur mulieres homines non esse." He also endeavours to prove, what naturally follows from this principle, viz. that women shall not be saved, that there is no future life or happiness for them. His proofs are all taken from Scripture, or founded on Scripture. Though, after all, his aim is not to much to degrade women to the condition of brutes, as to ridicule the principle or method of many Protestants, who, in points of controversy, admit of no proofs or considerations but what are taken from Scripture alone. This appears from the conclusion of the work. "Probavi, opinor, invictiffimis SS. literarum testimonii, mulierem non esse hominem, nec eam salvari: quod non effect, ostendi tamen universo mundo, quomodo hujus temporis haeretici, et pretenditi Anabaptisti, faciam solem explicare Scripturam, et quo utantur methodo ad abdiuindi sua exsanguina dogmatam."

Yet Simon Gecicus, a Lutheran divine, wrote a serious confutation of this piece in 1595, wherein the women are restored to the expectation of heaven, on their good behaviour.

The ancient Marcionites allowed their women to baptize; as we are assured by St. Epiphanius, Har. 42. cap. 4. the Montanists admitted women to the priesthood, and even the episcopate, Epiph. Har. 49. cap. 2. The modern Quakers also permit their women to preach and prophesy, on an equal footing with the men.

It is a point much controverted, how far learning and study become the sex? Erasmus handles the question at large in one of his letters to Budea. Lud. Vives, in his Institutio Fœminarum Christianarum, has a chapter expressly on the same subject. Madam Schurman, a German lady, has gone beyond them both, in a treatise on this problem, "Num femina Christianarum conveniat studium literaturi?"

Several of the women remarkable for learning have been also distinguished for their want of conduct. The reason, no doubt, lies in this; that their first studies lying in books of gallery and intrigue, the imagination was early turned that way, and the memory filled with a sort of ideas, which a favourable disposition, and age, adopted too easily, and improved too fast. It is not that study in itself has any natural tendency to produce such effects; rather the contrary: the close abstractive researches of metaphysics, logics, mathematics, phyfics, criticism, &c. no doubt would be the surest means to secure and establish the virtue of continence in a woman.

For an account of women hired to weep at funerals by the Romans, see PRAEFICE.

Women were allowed to sing, in 1772, in the collegiate church of St. Gudula, at Bruges. It was in the performance of high masses on a Sunday, when a considerable number of voices and instruments were assembl'd in the choir; and we were glad to find among the former two or three women, who though they were not fine fingers, yet their being employed, proved that female voices might have admission in the church, without giving offence or scandal to piety, or even bigotry. If the practice were to become general, of admitting women to sing the soprano part in the cathedrals,
it would, in Italy, be a service to mankind, and in the rest of Europe render church music infinitely more pleasing and perfect; in general, the want of treble voices, at least of such as have had sufficient time to be polished, and rendered steady, destroys the effect of the best compositions, in which, if the principal melody be feeble, nothing but the subordinate parts, meant only as attendants, and to enrich the harmony of the whole, can be heard.

WOMEN. Appeals of. See APPEAL.

WOMEN, Jury of. See Jury of Matrons.

WOMEN, Stealing of. See Seduction of.

WOMBS, Matrix, or Uterus, in Anatomy, that part of the female of any kind, wherein the fetus is conceived and nourished till the time of its delivery. The ancient Greeks called the matrix, μητρός, from μητέρα, mother: whence disforders of the womb are still frequently called fit of the mother. They also call it υτρός, as being the laik of the entrails, by its situation. Sometimes they also call it χώρος, or natura; and υνερέα, from υνερε, to fold, or envelop, or from υνερε, doors. See UTERUS.

WOMB, Dropsy of. See DROPSY.

WOMB, Falling down of. See PROCIDENTIA UTERI.

WOMB, Inflammation of. See INFLAMMATION.

WOMB, Suffocation of. See SUFFOCATION.

WOMB, Ulcers of. See ULCERS.

WOMB, in Geography, a town of Sweden, in the province of Skonen; 12 miles E. of Lund.

WOMBACH, a town of Germany, in the county of Rieneck; 3 miles S. of Lohr.

WOMBEAT, in Zoology, an animal of which Mr. E. Home has given an anatomical description in the 2d part of the 9th volume of the Philosophical Transactions. It was brought from the islands in Bassa's straits, and lived with him in a domesticated flat for two years. Whenever it had an opportunity, it burrowed in the ground, and covered itself in the earth with surplishing quickwells. It was quiet in the day, but in conflant motion during the night; very sensible of cold; ate all kinds of vegetables; was particularly fond of new hay, which it ate flatk by flatk. It appeared attached to those to whom it was accustomed, and who were kind to it. It allowed children to pull and carry it about, and when it bit them it was not in anger or with violence. It appeared to have arrived at its full growth, weighed about twenty pounds, and was about two feet two inches long. Another animal called the 'Koala,' is a species of the wombat, partaking of its peculiarities. It inhabits the forests of New Holland, about fifty or sixty miles S. W. of Port Jackson, whither it was brought in August 1803, and is called by the natives the 'koala wombat.' It is commonly about two feet long and one high; in the girth about a foot and a half; it is covered with fine soft fur, lead-colored on the back and white on the belly; the ears are short, erect, and pointed; the eyes generally ruminating, sometimes fiery and menacing; it bears no small resemblance to the bear in the fore-part of its body; it has no tail; and its customary posture is sitting. The New Hollanders eat the flesh of this animal; and are very dextrous in the pursuit of it, climbing with wonderful rapidity the loftiest gum-trees in search of it. The koala feeds upon the tender flotts of these trees; and during the day refts on the tops of them, either feeding at cafe, or sleeping. In the night it defends, prowls about in search of some particular roots, creeping rather than walking; and when incensed or hungry, it utters a long shrill yell, and assumes a fierce and menacing look. These animals are found in pairs, and the young is carried by the mother on its shoulders. It soon forms an attachment to the person who feeds it.

The external form of the wombat has been described by M. Geoffroy, in the 2d volume of the "Annales du Museum National de France;" and several parts of its internal structure have been taken notice of by M. Cuvier, in his "Lecons d'Anatomie Comparée." The mechanism of the bones and muscles of the hind legs differs in many respects from that of all other animals, except the koala. This has been minutely examined and described by Mr. Brodie, at the desire of Mr. Home; and it appears that there is nothing similar to it in the hind legs of the mole, or other burrowing animals. The internal structure of the wombat resembles that of the beaver; but it is so different from that of the kangaroo, and all the other animals of the opolium tribe, that it forms a very extraordinary peculiarity. The male and female organs of generation have been described; the former by M. Cuvier, and the latter by Mr. Bell in New South Wales. The male and female organs of the wombat and koala are similar to those of the opolium; and hence it is concluded, that these animals form the intermediate link between the opolium and kangaroo. See DIDELEPHIS.

WOMBINELLORE, in Geography, a town of Hindoostan, in Baramaul. It was taken by the British, under general Meadows; 100 miles S. E. of Serimgapatam. N. lat. 11° 43'. E. long. 78° 15'.

WOMBORN, a township of England, in Staffordshire; 3 miles S. W. of Wolverhampton.

WOMELS DORF, a town of Pennsylvania; 15 miles W. of Reading.

WONDA, a town of Africa, in Manding; 30 miles N. E. of Kamalia. See MANDING.

WONDA, a river of Manding, which, at Fonilla, a small walled village on its banks, is called Ba Woolima (red river); and towards its source it has the name of Ba Qui (white river); the middle part of its course being called Wonda. WONDER. See MIRACLE.

The seven wonders of the world, as they are popularly called, were, the Egyptian pyramids; the mausoleum erected by Artemis; the temple of Diana at Ephesus; the walls and hanging gardens of the city of Babylon; the colossus, or brazen image of the sun, at Rhodes; the statue of Jupiter Olympus; and the pharos, or watch-tower, of Ptolemy Philadelphus; instead of the latter, some reckon the royal palace of Cyrus, built by Menon, the stones of which were cemented with gold. See PYRAMID.

WONDERFUL WATER. See WATER.

WONDRA, or WONDRED, in Geography, a river which rises in Bavaria, and runs into the Egra, near Königberg, in Bohemia.

WONDZEGOW, a town of Bohemia, in the circle of Kaurzim; 10 miles W. S. W. of Kaurzim.
WOOSDORF, a town of Prussia, in Natangen; 25 miles S.E. of Königsberg.

WOSENS. See Wunsiedel.

WONTAMITTA, a town of Hindoostan, in Myfore; 45 miles E. of Chinna Balaram.

WOO-CHIN, a town of China, in the province of Kiang-si, near the lake Poyang, which is a place of considerable importance, as the great mart for exchanging commodities between the north and south of China. The warehouses are spacious and well filled, dwelling-houses large and substantial, temples richly decorated, and the shops filled with articles of all kinds, including no inconsiderable proportion of European goods. Here are several small bronze vessels of ancient and modern workmanship, not unlike the Grecian and Etruscan. Near it is a temple dedicated to Wang-thin-choo, the god of longevity, surpafsing most others in riches of carved-work and gilding.

WOOD, William, F.L. S., in Biography, a Protestant dissenting minister of distinguished reputation for general literature and science, character, and usefulness, was born at Collingtree, a village near Northampton, on May 29, O.S. 1745. His father, though occupying a humble station, was a person of approved integrity and piety, in connection with the Christian society at Northampton, under the personal care of the justly-celebrated Dr. Doddridge, and paid particular attention to the religious instruction and moral conduct of his children. Mr. Wood, at an early age, manifested promising talents, and having finished his school-education under the late Dr. Addington of Market-Harborough, was introduced, at the age of 16, with a view to the ministrv, among Protestant dissenters, which was the object of his choice, to a dissenting academy in London, conducted at the time of his admission by Dr. David Jennings and Mr. (afterwards Dr.) Morton Savage, and before the close of his studies by Mr. Savage, Mr. A. Kippis, and Mr. A. Rees. The writer of this sketch can bear personal testimony to his exemplary conduct during the period of his continuation at the academy, and to the diligence and success which he prosecuted the various branches of literature and science to which his attention was directed. Few persons ever left a public seminary with superior qualifications for the exerceive of the profession to which he was devoted, and performed the duties of it, in the progress of a long and honourable life, more acceptably and more usefully. It was then the custom, admitting of few exceptions, to ordain ministers when they were elected by particular congregations, and introduced into the full discharge of the pastoral office; and soon, we understand, of the wisest and best of the Non-conformist ministers have lamented the too general discontinuance of this decorous practice, against which it is thought by many that no sufficient objection has been alleged. Ordination among Protestant dissenters is a public service, usually conducted at the place where the minister, who is ordained or set apart, is about to be settled; and collits of a sermon addressed to the people, a charge delivered to the person ordained, and prayers for a divine blessing on his future labours, and for the edification and prosperity of the Christian society with which he is connected. It has been sometimes accompanied with a confection of faith on the part of the person who is thus set apart; but this part of the service, having been misunderstood, is frequently omitted, though in cases which allow of unrestricted liberty, and in which the confection neither descends into a variety of minute particulars, nor contains any pledges that embarrass or restrain future free inquiry, it is thought to be unexceptionable. Ordination, however, among the persons to whom we now refer, is not conceived to impair any new qualifications or powers which the person ordained did not possess previously to this service, or to constitute him either a minister in general, or the pastor of any particular church. But to return from this digression: Mr. Wood was publicly ordained, and the occasion afforded an opportunity for many ministers of acknowledged reputation among dissenters to bear their united testimony to his talents and character. He commenced his public services at Debenham in Suffolk, on the 6th of July 1766, with a sermon peculiarly appropriate to the occasion, from Luke, ix. 26., and he spent the remaining part of this year, and a great part of the year 1767, in the vicinity of London, where he occasionally officiated to the satisfaction of those who attended, and gained the friendship of some of the most eminent of the dissenting ministers of that period. In September 1767, he settled at Stamford, in Lincolnshire; and removed from thence to Ipswich in November 1770, where he remained till the close of the year 1772. In 1773, having nearly completed his 27th year, he was unanimously chosen to succeed Dr. Priestley at Mill-hill chapel, Leeds, and in that connexion he continued till his death. About two years after his settlement with this congregation, he published a small volume consisting of twelve sermons on life and death, which entitled the author, in the judgment of a contemporary critic, to the character of a useful and elegant preacher. In 1780 he formed a matrimonial connection with a daughter of Mr. George Oates, of Low-hall, near Leeds, which lasted twenty-six years, and contributed in a high degree to his domestic felicity. By this lady he had four children, of whom three survived their parents.

Ardently devoted to the studies that were more immediately or more remotely connected with his profession, and attached by affectionate gratitude as well as interest to the congregation in the service of which he was engaged, and which claimed his most affiduous and respectful attention, he commenced for the benefit of the young a course of lectures, in the year 1785. These were comprehensive and improving; and though they were delivered once a fortnight, they lasted several years. Our limits will not allow us to avail ourselves of the detail, furnished by his excellent biographer, of the subjects which were discussed in this extensive course of useful instruction. It will be sufficient to observe, that they contributed no less to the information of those who attended them than to the reputation of the lecturer, as well as to the mutual respect and esteem which were thus cemented between Mr. Wood and his congregation. The public would probably have derived instruction from the perusal of them, if some circumstances had not occurred which rendered it necessary for Mr. Wood to devote a considerable part of his time and attention to subjects of a very different nature. Without abandoning the studies connected with his profession, he was led by the state of his health, and by some other considerations, to the pursuit of natural history, and particularly of English botany; but whilst he was thus occupied, he rendered his investigations subservient to the great object of his life and ministrv, the promotion of religion and virtue, as well as the personal satisfaction and future happiness of those with whom he was connected. His new pursuits were the means of introducing him to acquaintance and friendship with many eminent persons; and more especially with Dr. (now Sir James) Smith, the justly celebrated president of the Linnean Society. To Mr. Wood the good opinion and friendly regard of one, who commands the respect and esteem of all who know him, by mental accomplishments and moral qualities of the most excellent and engaging kind, must have afforded a satisfaction which, as we can testify from personal knowledge,
WOOD.

ledge, he very highly appreciated. The good opinion of such a judge of merit, in the department of natural history, which now engaged his attention, must have encouraged his affability and perseverance. He was thus qualified for contributing several valuable articles to this Cyclopædia, in the reputation and success of which the editor is happy to say he felt and expressed a peculiar interest. His contributions comprehended the botanical articles that occur, with some few exceptions, from the beginning of the letter B to the end of C; and the editor, who most sincerely lamented his death as a pupil and a friend, as well as a coadjutor in this work, would have found it difficult to supply the losses, if the kindness and condescension of the Linnean of our time, for so, it is hoped, we may be allowed to denominate him without offending his delicacy, had not relieved his anxiety, and amply compensated the injury which the botanical department of the Cyclopædia must have sustained.

Mr. Wood had attained, by his talents and cultivation of them, to so high a rank among his brethren in that part of the country where his lot was cast, that few public services occurred in which he was not expected to be active and conspicuous. Attached to liberty, civil and religious, from his youth, he had in his mature years thoroughly acquainted himself with the genuine principles of the British constitution; and accordingly he took occasion on the centenary of the Revolution, in 1788, to express his conviction and feelings in two sermons, which were afterwards published. In the three following years he took an active part in the application of the dissenters to parliament for the repeal of the test and corporation acts. In 1794 he preached a funeral sermon, on occasion of the death of the Rev. W. Turner, of Wakefield; and in the following year he performed the same service in consequence of the decease of the Rev. Mr. Ralph, of Halifax; the sermons which he delivered in both cases were published. The short account of Leeds which was this year communicated to Dr. Aitken for his History of Manchester deserves to be noticed, as he took great pains in exactly ascertaining the number of its inhabitants. About this time he commenced a course of education, addressed to young females, with a view partly to his own emolument, but principally for the benefit of those who were disposed to avail themselves of his instruction; and indeed few persons could be found capable of conducting such a course with greater satisfaction and advantage to those who attended it. His lectures occupied three years, and comprehended history, geography, natural philosophy, grammar, the belles lettres, natural history, mental and moral philosophy, and the evidences of natural and revealed religion. His next publication was his sermon occasioned by the death of the Rev. Newcome Cappe, which contained a very appropriate and judiciously-merited eulogy of his late revered friend. It was dedicated to Mrs. Cappe, who claimed from her talents and character, as well as relation to the deceased, a tribute of respect; and annexed to it some brief memoirs of Mr. Cappe's life. In the year 1801, Mr. Wood published a liturgy, consisting of five forms, for the use of his congregation at Millhill chapel, and composed, for the most part, from the service of the established church, the Liverpool, Shrewsbury, and other liturgies before published by the dissenters, as well as from a similar service composed by the Rev. T. Simpson. Of this performance it will be sufficient to state, that it was executed with judgment and taste. On the restoration of peace in the year 1802, he published an animated discourse, which he delivered, in the course of his public services, on that occasion. About this time he exerted himself in establishing at York the academical institution, which had for some years subsisted at Manchester, and which was likely to be discontinued in consequence of the resignation of the late Rev. G. Walker, the theological tutor. Intending, as he advanced in life, and when he had finished the education of his daughter, to relinquish the anxiety and labour of tuition, he proposed to engage in some literary undertakings. Accordingly he was a contributor, in the department of natural history, to the Annual Review; but the work which occupied his chief attention, and which afforded him the greatest pleasure, was the Cyclopædia already mentioned.

As a preacher, the last of his publications was a sermon delivered at Birmingham, June 9, 1805, for the benefit of the Protestant dissenting charity-school, supported by the joint contributions of the two societies of the old and new meeting-houses. After his return from an excursion in the months of July and August 1806, he was attacked by a severe paroxysm of the gout, to which he had long subject; and in a few days his disorder was so alarming, that his recovery was not expected. As an aggravation of his distemper, the affectionate partner of his life was seized with a disorder, which terminated in her death. For some time his state was such, that it was prudent to conceal him both from the progres and termination of her disorder. The mournful event which he apprehended was gradually disclosed to him; and he received the afflictive intelligence with a degree of composure and resignation, which evinced the efficacy of his religious principles, and the consolation derived in such circumstances from Christian hope. During a long illness, which interrupted his public labours, and which was attended with a considerable expense, the society with which he was connected had an opportunity of testifying, by substantial acts of kindness, the high sense they entertained of his meritorious services. Providence at length restored his health to such a degree, that he was able to resume his public labours; but they were of no long continuance. On Sunday the 27th of March 1808, he performed the usual services with an uncommon degree of animation. On the following day, however, having previously experienced symptoms of a flying gout, he was suddenly seized at dinner with a violent sickness, which continued for many hours. This was succeeded by an inflammation of the bowels, which soon terminated in a mortification. The consequence was a delirium; and on Tuesday, the 6th of April, he expired so quietly, that the friends who attended his bed were not apprised of the moment of his departure. Those who wish for further information concerning the natural talents and acquired endowments, the private character and public services of Mr. Wood, will be amply gratified by the perusal of the "Memoirs of his Life and Writings," and of the "Address and Sermon" delivered on occasion of his death, by his friend and neighbour the Rev. Charles Wellbeloved of York.

Wood, Anthony, the Oxford Antiquary, was born at Oxford in 1632, and entered of Merton college in 1647. Having commenced M.A. and acquired a taste for studies pertaining to antiquity, he pursued with indefatigable diligence both at Oxford and in London researches, which furnished him with materials for his "History and Antiquities of the University of Oxford," a copy of which he sold to the university in 1669 for 100l. It was written in English, but afterwards translated into Latin, under the inspection of Dr. Fell; and the version was published from the Oxford press in 1674, under the title of "Historia et Antiquitates Universitatis Oxonensis, dubus Voluminibus comprehensa," fol. The first part of this work includes the annals of the university, from its earliest period to the year 1648; and the second contains an account of all its particular foundations, endowments, officers, &c. The translation
is badly executed, and Wood, the original author, was
deficient of those qualifications that would have rendered
him a fit historian of a learned university. Another of
Wood's works was his "Athenæ Oxonienæ; or, an
Account, in English, of almost all the Writers educated at
Oxford, and many of those at the Sitter University, from
the year 1500." It was first published in 1691, 2 vols. fol.,
and soon after subjected him to prosecution in the vice-
chancellor's court for his account of lord Clarendon, and
to various other attacks, occasioned by his partialities, and
more especially by his strong bias in favour of popery. His
style is vulgar, and his sentiments illiberal and unphiloso-
phical; but his veracity entitles him to confidence. He
died in 1695, and bequeathed his books and papers to the
university of Oxford. A second edition of this work,
corrected and enlarged from the author's MS., was pub-

This curious and diligent antiquary, whose whole life was
spent in the service of the dead, and whose labours, since his
decease, have so much facilitated the inquiries, and gratified
the curiosity of the living, tells us, in the Memoirs of His Life,
written by himself, with monastic simplicity, that in 1651,
"he began to exercise his natural and infaatiable vigour to
mufick. He exercised his hand on the violin, and having
a good ear to take any tune at first hearing, he could quickly
draw it out from the violin, but not with the same tuning of
strings that others used. He wanted understanding, friends,
and money, to pick him out a good master, otherwise he
might have equalled in that instrument, and in singing,
any person then in the university. He had some companions
who were musical, but they wanted instruction as well as
he."

The next year, being obliged to go into the country to
try to get rid of an obdurate age, by exercise and change
of air, he tells us, that "while he continued there he followed
the plow on well-dayes, and sometimes plowed. He learned
to ring on the fix bells, then newly put up: and having
had from his most tender yeares an extraordinary ravishing
delight in mufick, he practised there, without the help
of an instructor, to play on the violin. It was then that he
turned his ftrings in 4ths, and not in 5ths, according to the
manner; and having a good ear, and being ready to fing
any tune upon hearing it once or twice, he could play it also
in a short time with the said way of tuning, which was
never knowne before."

"After he had spent the summer in a lonih and retired
condition, he returned to Oxon. And being advised by
some person, he entertained a master of mufick to teach
him the usual way of playing on the violin; that is, by
having every string tuned five notes lower than the other
going before. The master was Charles Griffith, one of the
musicians belonging to the city of Oxon., whom he then
thought to be a most excellent artist. But when Anthony
Wood improved himself in that instrument, he found he was
not so. He gave him 2r. 6d. entrance, and so quarterly.
This perfon, after he had eximtedly wondered how he could
play fo many tunes as he did by 4ths, without a director or
guide, tuned his violin by 5ths, and gave him instructions
how to proceed, leaving then a lefson with him to practice
against his next coming."

In 1653, he found that "heraldry, mufick, and painting,
did fo much crowd upon him, that he could not avoid them;
and could never give a reason why he should delight in those
studies, more than in others, so prevalent was nature, mixed
with a generosity of mind, and a hatred of all that was fer-
vile, fascinating, or advantageous for lucre fake."

"Having by 1654 obtained a proficiency in mufick, he
and his companions were not without silly frolicks, not now
to be maintained."—What should these frolicks be, but to
diglude themselves in poor habits, and like country-fidders
tscape for their livings. After frolicking about to Farring-
don fair, and other places, and gaining money, victuals, and
drink for their trouble, in returning home they were over-
taken by certain folders, who forced them to play in the
open field, and then left them without giving them a penny.
"Most of his companions would afterwards glory in this,
but he was ashamed, and could never endure to hear of it."

By 1656, his record informs us, that "he had a genuine
fkill in mufick, and frequented the weekly meetings of mu-
sicians in the house of William Ellis, organist of St. John's,
college, situated on that place whereon the theatre was built." Here
he gives a lift of the usual company that met and
performed their parts on lutes and viols; among these eight
were gentlemen. "The mufick-masters were, William Ellis,
bachelor of mufick, and owner of the house, who always
played his part either on the organ or virginal. Dr. John
Wilfon, the public professor, the belt at the lute in all
England: he sometimes played on the lute, but mostly pre-
cluded (directed) the comfort. — Curtesy, a lutenist,
lately ejected from some choir or cathedral church.
Thomas Jackson, a base-violist. Edward Low, then
organist of Christ church: he played only on the organ, so
when he played on that instrument, Mr. Ellis would take
up the counter-tenor viol, if any perfon were wanting to
performe that part. Gervase Littelton alias Welcot, or
Welcot alias Littleton, a violist. He was afterwards a
fingling-man of St. John's college. William Glexney, who
had belonged to a choir before the war: he played well
upon the base-viol, and sometimes sung his part. —
Proctor, a young man, and a new comer. John Packer, one
of the univeritie musicians; but Mr. Low, a proud man,
could not endure any common musician to come to the
meeting, much less to play among them. Of this kind I
must rank John Hafelwood, an apothecary, a flarched formal
citherpipe, who usually played on the base-viol, and some-
times on the counter-tenor. He was very conceited of his
skill (though he had but little of it), and therefore would be
ever and anon ready to take up a viol before his betters;
which being observed by all, they usually called him Hand-
lewood. The rest were but beginners. Proctor died soon
after this time. He had been bred up by Mr. John Jenkins,
the mirror and wonder of his age for mufick, was excellent
for the lyra-viol and division-viol, good at the treble-viol
and violin, and all comprehended in a man of three or four-
and-twenty years of age. He was much admired at the
meetings, and exceedingly pitied by all the faculty for his
lofs."

At this time Anthony Wood tells us, that "what by
mufick, and rare books that he found in the public library,
his life was a perfect Elyfium."

"Anthony Wood was now advised to entertain one
William James, a dancing-maftcr, to instruct him on
the violin, who by some was accounted excellent on that in-
strument, and the rather because, it was said, that he had ob-
tained his knowledge in dancing and mufick in France. He
spent in all half a yeare with him, and gained some improve-
ment; yet at length he found him not a compleat maftcr of
his facultie, as Griffith and Parker were not: and, to say
the truth, there was no compleat maftcr in Oxon. for that
instrument, because it had not been hitherto used in confort
among gentlemen, only by common muficians, who played
but two parts. The gentlemen in private meetings, which
Anthony Wood frequented, played three, four, and five
parts with viols, as treble-viol, tenor, counter-tenor, and
bass.
bais, with an organ, virginal, or harpsicon, joyd with them; and they esteemed a violin to be an instrument only belonging to a common fiddler, and could not endure that it should come among them, for fear of making their meetings to be vaine and fiding. But before the reftoration of king Charles II., and especially after, viols began to be out of fashion, and only violins used, as treble violin, tenor, and bafe violin; and the king, according to the French mode, would have twenty-four violins playing before him, while he was at meales, as being more airie and brisk than viols.

"In the latter end of the yeares 1657, Davis Mell, the moft eminent violint of London, and clock-maker, being in Oxon., Peter Pitt, William Bull, Kenelm Digby, and others of All Soules, as also Anthony Wood, did give a very handfome entertainment in the tavern called the ' Salvation.' The company did look on Mr. Mell to have a prodigious hand on the violin, and they thought that no perfon, as all in London did, could goe beyond him."

By connecting the scattered fragments of this zealous Diletante's life, which concern muffick, we shall be able to form an idea of the state of the art, not only at Oxford, but in every other part of the kingdom where it was more secretly practifed during the latter part of the Ufurpation.

Under the year 1658, Anthony Wood tells us, that "he entertained two eminent musicans of London, named John Gamble and Thomas Pratt, after they had entertained him with moft excellent muffick at the meeting-houfe of William Ellis. Gamble had obtained a great name among the people of Oxon. for his book of 'Ayres and Dialogues to be fung to the Theorbo, or Bafe-viol.' The other for feveral compositions, which they played in their concerts."

He then gives an account of the arrival of Baltzar, a wonderful performer on the violin, from Lubeck, arriving at Oxford, and deftoyng, by his great superiority of hand, all the little vanities, not only of the belf fiddle-players of the university, but of others from London, who had long enjoyed the reputation of great performers. See BALTZAR.

Anthony Wood pursues his musical records, and tells us, that "all the time he could fpare from his beloved studies of English history, antiquities, heraldry, and genealogies, he spent in the most delightful facultie of muffick, instrumenal or vocal; and if he had missed the weekly meetings in the houfe of William Ellis, he could not well enjoy himself all the week after. Of all or moft of the company, when he frequented that meeting, the names are fet downe under the year 1656. As for thofe that came in after, and were now performers, and with whom Anthony Wood frequently played, were thofe: Charles Perot, M.A. fellow of Oriel college, a well-bred gentleman, and a perfon of a sweet nature; Christopher Harrifon, M.A. fellow of Queen's college, a maggot-headed perfon, and humourous; Kenelm Digby, fellow of All Soule's college, he was afterwards Dr. of L., he was a violinf, and the two former violinf; William Bull, M.A. for the viol and violin; John Vincent, M.A. a violinf; Sylvanus Taylor, fellow of All Soule's college, violinf and angofinter, his elder brother, captain Silas Taylor, was a compositer of muffick, played and fung his parts; Henry Langley, M.A. a violinf and angofinter; Samuel Woodford, M.A. a violinf; Francis Parry, M.A. a violinf and angofinter; Christopher Coward, and Henry Bridgman, both masters of arts; Nathan Crew, M.A. a violinf and violinf, but alwayes played out of tune, as having no good care, he was afterwards bishop of Durham; Matthew Hutton, M.A. an excellent violinf; Thomas Ken of New college, afterwards bishop of Bath and Wells, he would be sometimes among them: and fong his part; Chrif-

topher Jefferyes, a junior student of Chrift church, excellent at the organ and virginals, or harpsicon, having been trained up to thofe instruments by his father George Jefferyes, organift to king Charles I. at Oxon.; Richard Rhodes, another junior student of Chrift church, a confident Weltmonafterian, a violinf to hold between his knees."

"These did frequent the weekly meetings, and by the help of publick matters of musicfick, who were mixed with them, they were much improved. Narciflus Murth would come oftimes among them, but seldom played, because he had a weekly meeting in his chamber, where matters of muffick would come, and fome of the company before-mentiond. When he became principal of St. Alban's hall, he translated the meeting thither, and there it continued, when that meeting at Mr. Ellis's houfe was given over, and fo it continued till he went over to Ireland, where he became afterwards archibishop of Tuam."

"After his majey's reftoration, when the matters of muffick were reforted to their feveral places that they before had lof, or gotten other preferment, the weekly meetings at Mr. Ellis's houfe began to decay, because they were only held up by fcholars who wanted directors and instrudors. So that thefe meetings were not continued above two or three yeares, and I think they did not go beyond 1662."

Our Oxford annalist terminates his account of the musical transactons of that university, during the interregnum, by the following anecdote.

"In October 1659, James Quin, M.A. and one of the fenuor students of Chrift church, a Middleflax man borne, but fon of Walter Quin; of Dublin, died in a crazed condition. Anthony Wood had fome acquaintance with him, and hath feveral times heard him fing with great admiration. His voice was a bafe, and he had a great command of it. 'Twas very frong and exceeding trouling, but he wanted skil, and could scarce finge in confort. He had been turned out of his students place by the visitors; but being well acquainted with fome great men of thofe times, that loved muffick, they introduced him into the company of Oliver Cromwell, the protector, who loved a good voice and instrumenal muffick well. He heard him finge with very great delight, liquored him with lack, and in conclusion faid, 'Mr. Quin, you have done very well, what shall I do for you?' To which Quin made answer with great compliments, of which he had command with a great grace, that 'your highnefs would be pleased to refume him to his students place; which he did accordingly, and fo kept it to his dying day.'

If this minute and indifferminate antiquary and biographer is sometimes thought to want taffe and flection fufficient to give his records due weight, it muft be ascribed to the confiant habit he was in of journalizing, collecting anecdotes, and making memorandums of every perfon, tranfaftion, and circumstance, that arrived at his knowledge, in the uncoth and antiquated language of his early youth. For this dialect being inelegant and vulgar, even when he learned it, renders his writings frequently ridiculous, though they contain fuch information as can be nowhere else obtained. But the few opportunities he had of knowing the gradual changes in our colloquial dialect, by converfing with men of the world, or even the language of elegant books by his favourite course of reading, degrade him to a level with writers infinitely his inferiors both in use and entertainment. An excellent apology has been made for his imperfections by the editor of his life, written by himself, and published in 1772; which is fo interesting, that he muft be an incurious inquirer, indeed, who, having dipped into it, is not sufficiently fatisfied by the original simplicity of the tyle and importance of
of many of the anecdotes, to give it an entire perusal before he lays it down. Anthony Wood was credulous, and perhaps too much an enthusiast in music to speak of its effects with critical and philosophical precision; however, without his assiduity, the state of the art at Oxford, and the academical honours bestowed on its professors, as well as memorials of their lives and works, would have been difficult to find. Upon his decisions in matters of taste, we are not always perhaps implicitly to rely. The high character he has given Dr. Wilton's productions and abilities may have proceeded from want of experience, knowledge, and penetration into the finer points of the art; and as to Dr. Rogers, his judgment of him seems to have been manifestly warped by friendship. Yet, upon the whole, it must be allowed that it is only from such minute records as those of Anthony Wood that any true and satisfactory knowledge can be acquired of the characters, manners, and domestic occurrences of our ancestors. The great features of history, and the events which occasion the ruin or prosperity of a state, must be nearly the same in every age and country; but comforts, conveniences, and the difficulties of private life, furnish the mind with reflections far more varied and interesting to the generality of mankind, than the rise of states or downfall of kings and heroes.

Wood, — a performer on the violin, who led the band many years at the theatre in Covent Garden, and father of Wood, his successor in that orchestra, organist of St. Giles's, and of Chelsea college. They were both active professors; but though performers only of the second clafs, they constantly ranked themselves of the first. Burney.

Wood, in Vegetable Anatomy, is that more or less hard and compact substance, which makes up the bulk of the trunk and branches of a tree or shrub, and is concealed from view by the bark. When cut transversely, the wood is found to consist of numerous concentric layers, very distinct in the fir, and the trees of cold or temperate countries in general; else so in those appropriated to a tropical climate. The external part of each circular layer being much the most hard and compact, often with somewhat of a horrid appearance, distinguishes the limits of each. Scarcely any two layers of the same tree are precisely alike, in the proportion which this compact part bears to the rest; nor does any one layer exhibit a precise uniformity of diameter in its whole circle. On the contrary, each layer is broader on that side of a tree where the exposure has been most favourable to its growth, where, consequently, there have been more branches and leaves, so as to yield a greater deposit of woody matter. Hence the layers being all, for the most part, broader on one side of a tree, their aggregate disproportion throws the common centre, or pit, very much out of the actual centre of the trunk. It having been remarked in felling trees, that the greatest breadth of the concentric circles is very often on their south side, a rule has been proposed for travellers to ascertain thereby the direction of the compass. But travellers must be strangely at a loss, if they could find no easier method of judging. Nor is the mode in question infallible. It would indeed shew on which side the growth of each particular tree had been most favourable, whether from its exposure, or the nature of the soil which its roots had met with; but this may not always be towards the south. We must lay to tell great part of a forest, to form a precise opinion; and the process would be, as it were,

"— to tell what hour o' the day,
   The clock did strike — by algebra."

The number of these concentric layers, in any tree, if it be found to the heart, very correctly demonstrates the number of years the trunk has been growing. This is a general opinion, and undoubtedly correct; provided the layers are well marked. The observer must be aware that each annual layer is composed of a great number of thinner and fearely distinguishable ones, which occasionally assume a more conspicuous appearance than usual, in consequence of fluctuating seasons, or any accidental checks in the growth of a tree, as hard winters render the outside, or hornry part, of each circle, more decided; while favourable summers make the circle itself altogether broader. But there is always a sufficient distinction between summer and winter, beyond the tropics, to establish the above rule. Ever-greens, for the most part, and trees of hot countries, exhibit lighter traces of these concentric layers; but they may be discerned in every mahogany table. Monocotyledonous plants have been said to be entirely without any such annual structure. But there is no reason why they should necessarily be so. Mr. Salisbury once demonstrated this structure to us in a Dracaena; and its absence in palms and ferns is to be attributed to a peculiar mode of depositing wood in these plants, rather than to their being monocotyledonous. What has been said already under the articles Circulation of Sap, and Cortex, will sufficiently explain this. As the inner surface of the bark deposits the matter of the wood, it must lie in concentric circles; and in proportion as this operation goes on more constantly and uniformly, these layers must be the more homogeneous and uninterrupted. Perennial roots of herbaceous plants often exhibit concentric circles, of annual formation, even in hot climates, as may be seen in Jalap. Each circle, no doubt, marks the increase which has taken place in each successive season; and while the herb is not growing, nothing is added to the root.

The theory of vegetation, as explained in the articles just cited, shews the reason of the spiral-coated vessels being found in the young wood only, and not in the bark. Those vessels, formerly supposed to contain air alone, are the real arteries of the plant, and convey its sap, or blood, through the wood, to be returned through the bark, where it deposits particular secretions. This theory also explains why the alburnum, as being the layer of unhardened wood for the present year, is tender, and even a mere jelly, at one period. But the bark is in the spring of the year, before the deposit of wood begins, most readily stripped from the tree; though it also readily, and without harm to the tree, comes off in winter, while vegetation is at a stand.

We scarcely need here detail the experiments of Du Hamel, to determine whether the wood forms the bark, or the reverse. Thin metallic plates introduced between these two parts, and carefully bound up, threw, after a few seons, when the branch thus treated was cut across, that the bark had deposited layers of wood on the outside of these foreign substances, with little or no prejudice to the growth of the plant. But Dr. Hope's experiment (see Cortex) is still more strikingly decisive. The Linnaean hypothesis, that the pith added a layer every year to the wood internally, is thus entirely set aside. Indeed nothing but a preconceived theory, of the great importance of the pith, and its analogy to the medullary or nervous system of animals, (for the support of which opinion arguments are not wanting,) could have led to erroneous a conclusion. It is sufficient to remark, what indeed could not escape the intelligent author of this hypothesis, that trees grow vigorously, though their heart
is become rotten by age, when the pith, with numerous adjoining layers of wood, have long since been obliter-
ated.

A transverse section of the wood of a tree displays various vessels, and other parts, which microscopic authors take delight in exhibiting; but, without a scientific expla-
nation, little is to be learned from their plates, how-
ever beautiful to the eye. Silicous petrifications, of oak-
wood especially, fine specimens of which are brought from Hungary, shew its vascu lar structure in the greatest perfe ction. In the sections to which we have just allu-
ded, the pith, with its highly cellular texture, makes a conspicuous appearance in the centre. In the body of the wood, the sap-vessels are generally the largest and most numerous. These, when young and tender, easily display their spiral coats, if pulled aside longitudinally; but are not found at all in the bark. Among them, in the resinous trees like the fir, or any that abound with secreted fluids, as the fig, much larger vessels are inter-
spersed through the wood and bark, in which the peculiar se cretions are lodged. But besides the determinate and continued concentric layers of wood above-described, numerous thin plates are interpersed, known to workmen, especially in oak-wood, by the name of the Silver Grain. (See that article.) Mr. Knight, who is there quoted, further remarks, that if a board of English oak be cut for a floor, in such a direction, that the lamina of the silver grain lie parallel with the surface of the board, it is rarely or never seen, when properly laid, to deviate from its true horizontal position. But a board faved, on the contrary, across the silver grain, “will, during many years, be in-
capable of bearing changes of temperature, and of moist, without being warped; nor will the strength of numerous nails be sufficient entirely to prevent the inconvenience thence arising. That surface of a board of this kind which grew nearest the centre of the tree, will always shew a ten-
dency to become convex, and the opposite one concave, if placed in a situation where both sides are equally exposed to heat and moisture.” Knight, Phil. Trans. for 1801, 345.

This writer adds, that the small clefts in the surface of an oak-tree, frizzled of its bark, and exposed to the sun and air, are caused by the plates of the silver grain having parted from each other. They will long continue to open and close again with the changes of the weather. In the middle of a dry day they are open, but much less so during the night. After long exposure to the air and light, wood loses this property. Knight as above.

A different degree of hardnecf, and in some trees a remark able difference of colour, exists between a number of the external concentric layers of the wood, and about as many or more of those next the centre. These latter are called the heart of the timber; the former the sap or alburnum; but these are vulgar appellations, and the latter especially are improper. The true alburnum is the layer of new unhardened wood of the present year, which also workmen often term the sap. The sap, properly so called, is the fluid from which all their secretions, and even the wood itself, are formed. (See that article.) Those who use wood for mechanical purposes are well aware of the above difference between its different parts, however incorrect the names by which they are distinguished. The softer ex-
ternal layers have little durability in comparison with the heart. They retain more of the vital principle, and more of the peculiar juices of the plant in a fluctuating condition, liable to be acted upon by external or internal causes, and not yet united, in a fixed state, to the solid body of the old wood. This change, however, is not limited in any particu-
lar kind of tree to a determinate period in the age of each layer of its wood, nor even to any determinate series of the concentric circles of any individual tree. It often extends to a greater number of rings on one side than on another. The more vigorous there is in a tree, or in any side or portion of its trunk, the sooner is the alburnum, to use its popular denomination, made perfect wood, or heart.

The term wood, philosophically speaking, is not confined to the substance of a tree. The central part of a root, dis
tinguished from its bark, is the wood, and in many perennial roots consists, as we have already mentioned, of several dif tinct layers. In a carrot, the yellow part is the wood, en-
compassed by a thick reddish bark. In a turnip, the woody part is of ample dimensions, while the bark is thin.

A most remarkable difference exists between the solidity of the wood in some trees and in others. Some wood is so heavy as to sink in water; some is as light as cork, or even lighter. In general, wood of different trees, of the same natural order, poifefes similar properties and the same degree of value. But there is often, in the same genus, a most remarkable difference between the finness of the wood of different species, for particular purpofes. The oaks (see Quercus) abundantly exemplify this fact. The very hard and ponderous timber of $Q. ilex$, the live oak, however lafitting in a dry situation, is so prone to deterioration when exposed to wet, as to be among the most worthless in the world; its hardines and heaviness only rendering it the lefs fit for ufe, where it would be likely to endure. On the other hand, many of this genus afford timber more or lefs useful in every circumstance and situation, among which our English Q. Robur stands pre-eminent. See Timber.

All kinds of wood are to be preferred from the worm, and from many other occasions of decay, by oily subftances, particularly the effential oils of vegetables. Oil of spike is excellent, and oil of juniper, turpentine, or any other of this kind, will serve the purpose; these will preserve tables, instruments, &c. from being eaten to pieces by these ver-
mim, and linseed-oil will serve in many cafes to the same pur-
pofe; probably nut-oil will do also, and this is a sweeter oil, and a better varnish for wood.

The ingenious Dr. Hales, whose attention was uniformly directed to schemes of domestic or national benefit, was in-
duced by the great damage done to shipping by worms to pro-
pose various methods for preventing it. Oily, unctuous materials, he apprehends, are not likely to penetrate deep into oak, which has a watery sap; but oil is known to pe-
etrate far into fir, and to give it a very considerable degree of toughnes. He therefore proposes to mix with oil aplied to the fir-boards with which ships are sheathed some ingredient that is disagreeable to the worms; and he appreh-
ends that a small proportion of verdigrife used in the opera-
tion of paying would be of great service: or if copper-
filings were mixed with the paying, sea-water would turn
them into verdigrife. It might be useful to soak planks in
water strongly impregnated with verdigrife.

Mr. Reid recommends the trial of the acid juice of tar, prepared either with copperas or ochre, for preserving ships either from rotting or worms.

In the East Indies, it is said, they have an efectual way of preventing worms from destroying their ships, by paying them first with a mixture of mulkard, oil, and lime of shells, and hog’s blood: they then sheath the ship, and renew it after some years.

The following receipt has been recommended by a person who never knew it fail of success. Take 100 lbs. of the fineit
finest pitch; melt it over a slow fire of coal, and add to it, when melted, 30 lbs. of rolled brimstone grossly bruised, and boil the whole till 30 lbs. are volatilized. The matter thus prepared must be kept in cafins in a dry place, and when it is to be used, melt 100 lbs. of it, and add gradually 35 lbs. of brick-dust or marble-dust, fitted and well heated. The composition, when used, must be very hot, and the boards dry.

An ingenious ship-builder observes, that turpentine and brimstone form the best composition he has met with, and comes home from a voyage with least damage.

East India ships are first sheathed, and that sheathing is filled with small broad-headed nails, which is a safe and effectual defence from the worms, and soon becomes a continued cake of rust, and not liable to be damaged by cables, or common accidents. See Pay and Ships.

The following, says Dr. Hales, is an approved method of preparing the boards and timber of out-door work: viz. melt 6 lbs. of pitch, and add, by fitting, 1 lb. of dried brown Spanish, or whitening, and a quart of linseed oil. Hales's Ventilators, part i. p. 164, part ii. p. 289, &c.

Dr. Lewis observes, that though tar has been used for preferable wood, and also for coating common tiles, in imitation of the black glazed tiles, which are fold at a much higher price, both tar and pitch are of themselves too soft for these intentions, being liable to be melted off by the summer heat: and, therefore, different powdery substances, as ashes, ochres, and other mineral pigments, have been mixed with them.

In the Swedifh Transactions for 1740 and 1742, two compositions are recommended, which are said to be firm, durable, and glossy. One is prepared by melting the tar over a gentle fire, so as to make it fluid, but not to boil, and stirring in as much coal-dust or powdered charcoal as will render it thick: the other is prepared by mixing the melted tar with a sufficient quantity of lamp-black. Coatings formed of these mixtures are, however, liable to be considerably softened by the heat of the sun. The mixture of powdered pitch-coal and melted tar, made of such a consistency as to be freely spread while warm with a brush, is less liable to soften than either of the other two. The tar obtained from coal, in the method lately discovered by the earl of Donald, appears from various testimonies of those who have tried it to be much better calculated to preserve wood and iron, as well on land as in water, than vegetable tar. It has also this peculiar advantage, that it will not admit or harbour those worms that are so injurious to the bottoms of ships at sea. See an Account of the Qualities and Uses of Coal and Coal-varnish, &c. by the Earl of Donald, 8vo, 1785.

Mr. Parkes recommends, for the preservation of wood, the tar which is obtained from the pyroxylineous acid. See TAR.

Dr. Lewis observes, that the coating or painting of wood does not in all cafes contribute to its preservation: unless the wood be very thoroughly dry, especially those kinds of wood whose juices are not oily or tenacious, the painting by confining the watery sap, hinders the corruption. Com. Phil. Techn. p. 363, &c. On this subject, see Timber.

Some of the West India trees afford a sort of timber which, if it would answer in point of size, would have great advantages over any of the European wood, in ship-building for the merchant-service, so that it will ever touching this timber. The acajou, or tree which produces the casewheat-nut, is of this kind; and there is a tree of Jamaica, known by the name of the white-wood, which has exactly the same property, and so have many other of their trees. Phil. Tranf. No 36.

To preserve wood expeditiously for sea-service, it has been usual to bake it in ovens.

The art of moulding wood is mentioned by Mr. Boyle as a defideratum in the art of carving. He says he had been credibly informed of its having been practised at the Hague; and that the effect of it might have been performed by some method of that softens the wood, and afterwards allows it to harden again, in the manner that tortoise-shell is moulded. Or, perhaps, by reducing the wood into a powder, and then uniting it into a mass with strong but thin glue. And he adds, that having mixed saw-dust with a fine glue made of shingles, slightly training out what was superfluous through a piece of tissue, the remainder, formed into a ball and dried, became so hard as to rebound when thrown against the floor. Works abr. vol. i. p. 130. See GLUE.

The people who work much in wood, and that about small works, find a very surprising difference in it, according to the different seasons at which the tree was cut down, and that not regularly the fame in regard to all species, but different in regard to each. The button-mould makers find that the wood of the pear-tree, cut in summer, works toughest; holly, on the contrary, works toughest when cut in autumn; box is mellowest when it has been cut in summer, but hardest when cut about Easter; hawthorn works mellow when cut about October, and the service is always tough if cut in summer. Merret's Notes on Neri, p. 265.

It is a very well-known quality of metals to be longer and larger when hot, and shorter and smaller when cold; a thousand experiments prove this, and the books of experimental philosophy have sufficiently expatiated upon it; on the contrary, it is found to be the property of wood, that it is longest in cold weather and shortest in hot; this change is owing to the remains of the sap yet in the wood, which being congealed by cold, is enlarged in its surface, as all liquors are, when frozen into ice; and shrinks into a less space or bulk again, when liquated by heat.

It follows from this that all wood must change its surface more or less, according as it contains more or less sap, and this may be made a test of great use for the determining what kinds of wood have most, and what least sap. This would be a very valuable piece of knowledge, since there are many uses for which that sort of wood must always serve best, which has the smallest quantity of sap remaining in it. See Hygrooscope.

Thus, in the great article of preferring flour, no barrels are at present used but those of seasoned dry oak; the whole advantage of this wood is, that it contains less sap than others; for the sap in the wood makes the flour damp, and it then becomes rancid, and breeds worms. (See Meal.) So that if any other wood can by this means be found out to contain less sap, when dried in the common way, than oak does, it will be so much the better for this purpose; or, if a cheaper wood should be found only to contain as little sap as the oak, it would do as well, and the price of oak would be saved in these vessels.

A proper way of trying when the sap was sufficiently expelled out of trees, might also be found by this experiment, and much benefit would accrue from it; for our ships, when made of timber not sufficiently dried, prove injurious to the health of people on board; and it has been remarked, both by the French and ourselves, that many more men in general die in the first voyage of a new ship than in the same time in an old one; and indeed the first six months are usually ob-
served in this cafe to be most fatal. The exhalation of the vapour from the wood of the vessel is certainly the occasion of this, and if it could be contrived to have this vapour properly exhausted before the timber was used, it would not only prevent this mortality among the men, but the vessel itself would be the founder and the better for it. Deflandres, "Traité de Phys.

Woods are distinguished into divers kinds, with regard to their natures, properties, virtues, and uses. Of wood, considered according to its qualities, whether useful, curious, medicinal, &c., the principal is that called timber, used in building houses, laying floors, roofs, machines, &c. See Timber.

Woods valued on account of their curiosity are, cedar, cedron, mahogany, walnut-tree, box, calamus, &c., which, by reason of their extraordinary hardness, agreeable smell, or beautiful polish or grain, are made into cabinets, tables, combs, beads, &c.

The medicinal woods are, guaiac, which the Spaniards call lignum foetido; aloes, or agallochum; sassafras, nepthrichum, fustic, logwood, paphcalamum, eagle-wood, or pan d'aguila, &c.

Woods used in dyeing are, the Indian wood, Brafk, Camphere, &c.

In extracting the colouring-matter of dye-woods, and in making some other colours for the use of calico-printers, Mr. Parkes observes (Chem. Eff. vol. ii.), that it is of great convenience to heat the vessels by steam; for by this method of preparing decoctions, the workmen are prevented from ever giving the materials a greater heat than that of 212°; and the injury which was formerly done by the burning of the grooves in the bottom, and sides of the copper is avoided. Several manufacturers, says this ingenious chemist, have now adopted this method. This leads us to take notice of a beneficial application of charcoal, as a slow conductor of calorics, for preserving an equal temperature. Ground charcoal, it is said, will conduct heat more slowly than even dry sand, in the proportion, according to Guyton, of three to two. Accordingly, all those vessels which are heated by steam, if they were made double, and the space between the inner and outer vessel filled with ground charcoal, the heat would be so prevented from escaping, that any given temperature might be maintained for a long time, and thus there would be a materialsaving in the article of fuel. Moreover, when churches, or other large buildings are to be warmed by steam, those parts of the conducting-pipes which are not within the buildings should be always surrouned in this manner, and then no heat could escape until it had been conveyed to the space which it was intended to warm by it. Thus also in the manufactories of flax, paper, gunpowder, blue, and a variety of other articles, every part of the apparatus for drying these by steam, and which is not actually within the drying-rooms, ought to be secured in the same manner. The common steam-working apparatus, and other culinary utensils, would be much improved by being fitted with double covers, and by filling up the intermediate spaces with aeronaceous matter. Moreover, by securing the conducting-pipes in this manner, buildings might be eventually warmed, and processes conducted at any distance from the boiler, as steam is the most faithful carrier of heat that can possibly be; for it cannot deposit it on any bodies that have already acquired the temperature of 212°. It is also this non-conducting property of charcoal that renders it so common, says Fourcroy, cited by Parkes, in France as material for coating furnaces, and for confining the heat, to which use its incombusible nature adapts it in a peculiar manner, as it is the most refractory body that is known, provided it be excluded from oxygen. Charcoal is applicable to other purposes in domestic economy; such as the preserving of animal food from taint, by covering it with a few pieces of fresh-burnt charcoal, and the recovery of it by boiling it for some minutes in water with a few ounces of such charcoal. By the same means, mollases or treacle may be deprived of its disagreeable taste, so that it might be used instead of sugar. A patent has likewise been taken out for refining sugar by means of charcoal by M. Croflet, who required for it, of the joint body of sugar-bakers in London, a remuneration of 50,000l.; and Mr. Parkes apprehends, that in a small concern of this kind established in the metropolis, which manufactures double oaves of a finer quality than those of any other house, the purpose is effected by the same means. The empyreumatic flavour acquired by some brandies in distillation may be removed, says the ingenious writer now cited, by digesting some in charcoal; and common malt-vinegar, boiled on charcoal, becomes colourless, without losing its strength. Water, which in long voyages acquires a disagreeable taste and smell from long standing in the wooden casks, may be purified by filtration through ground charcoal; or it may be kept sweet in casks that have been charred withinside.

For the above-mentioned purposes, the charcoal should be fresh made, or heated red-hot under a cover of sand, immediately before it is used; and the requisite quantity should be previously ascertained by experiment. In some cases, it should be used in the form of powder, having been pounded immediately from the fire, before it has been exposed to the air, and the refuse should be preferred for future use in bottles closely stopped. For other uses to which charcoal is applied, see CHARCOAL and CARBURI.
WOOD.

off in sparks during combustion, which the coal of the wood itself seldom does. The charcoal of wood is said to be essential to the perfection of bar-iron; but when wood became scarce, and government restricted its use, cinders and coke were substituted for it; and thus the quality of English iron was so much debased, that Ruffian and Swedish iron, which is prepared by means of the coal of wood, are employed by those who work in this metal. The superior quality of the iron made with charcoal is attributed by M. Haffenratz to its combination with potash. It was by Sir Eliz. c. 14, that it was enacted, that no oak, beech, or ash-timber, one foot square at the hub, should be converted into charcoal for making iron in any part of England or Wales, except in the county of Suffolk, the weald of Kent, and certain parishes in the county of Surrey. This restriction led to the practice of making bar-iron with the coke of pit-coal, the method of preparing which was kept a secret from the generality of the trade. When Mr. Henry Horne published his "Essays on Iron and Steel," in the year 1773, he gave directions for a better method than they had before known of charring pit-coal, fo as to make it a proper fucce- cedanum for wood-charcoal in the manufacture of iron. Since that time the coke of pit-coal has come into very general use, so that the consumption of this substance is now very considerable. (See Coke.) Crayons of charcoal are belt made of the willow; whereas the coals of the hard woods, such as box and guaiacum, are much harder than others, whist the charcoal of the kernels of fruits is quite soft and friable. As a pigment, the coal of ivory, or that which is procured by burning real ivory in closed vessels, is the most intensely black, and the most beautiful. The belt charcoal for use as a powder for cleaning the teeth is made from the shell of the cocoa-nut. The difference between the charcoals of animal and vegetable substances may be determined by the following test. A vegetable coal will burn on a red-hot iron into white ashes, which will be readily dissolven by sulphuric acid into a bitterish liquor; whilst the ashes of animal substances are little affected by that acid, and form with it a compound with a very different taste. (See Ashes, Carbon, Charcoal, and Gun-Powder.) For the method of charring wood, see Timber and Char- ring of Peat. This appears to have been a very ancient practice. The pikes that formed the foundations of the Temple of Diana at Ephesus, not long since taken up, appeared to have been charred; and about fifty years ago some oak-rafts were found in the bed of the Thames in the veriest spot where Tacitus says that the Britons fixed a number of such rafts, to prevent the passage of Caesar's army; and these rafts, which were charred to a considerable depth, had completely retained their form, and were firm at the heart. About sixty years ago one of the timbers that supported Trajan's bridge over the Danube, near Belgrade, was taken up, and the outer part, to the depth of half an inch, was found to be converted into an agate, the inner part being slightly petrified, and the central being still perfect wood, though this timber had been in the water 1700 years. (See Kirwan's Geological Essays, cited by Parkes in his Essays, vol. ii.) Many other instances occur of wood petrified and converted, more or less, into agates of various colours. Writers on this subject have recommended the practice of charring every piece of wood before it is placed in the ground. Dr. Watson, (late bishop of Landaff,) in his "Chemical Essays," vol. iii. suggests the propriety of charring all the wood that is used in mines and subterraneous drains, and particularly that which covers troughs, through which a current of water passes, and which rot in a few years by the alternate change of wet and dry. In this connection we may add, on the authority of Chaptal, in his "Chemistry applied to the Arts," that when old chestnut and other trees are rotten within the trunk, and threatened with speedy destruction by the progress of the carious trunk, it may be stopped by applying fire to the decayed part, so as to char the whole of the neighbouring surfaces.

Wood, in Gardening, is a term used to signify the shoots or branches left in fruit-trees. See Pruning, &c.

Wood, an epithet applied to various sorts of weeds. See Weed.

Wood and Bark of Tree, Canker or Ergot of, in Agriculture and Gardening, a diseased state in these parts of them. It has been flaved by a late philosophical writer, that the cauce seems to be an excess of alkaline and earthy matter in the descending sap, as he often found carbonate of lime on the edges of the canker in apple-trees; and that ulinum, which contains fixed alkal, is abundant in the canker of the elm. The old age of a tree, in this respect, is, it is thought, faintly analogous to the old age of animals, in which the secretions of solid bony matter are always in excess, and the tendency to ossification great.

It is suggested, that perhaps the application of a weak acid to the diseased part might be of use; or that where the tree is of great value, it might be watered occasionally. See Canker.

Wood, Lignin? in Chemistry, the substance which constitutes the bals of wood usually so called.

To obtain this substance in a state of purity, it is necessary to digest wood in a sufficient quantity of water and afterwards of alcohol, by which means all foreign substances soluble in these fluids will be removed; the simple woody fibre will thus remain, which poffeeds the following properties.

It is composed in general, of longitudinal fibres easily separable from one another. These fibres, when very much subdivided, become somewhat transparent. They have no smell nor taste, and are not altered by exposure to the atmosphere.

The woody fibre is insoluble in water and alcohol. It is soluble in a weak alkaline solution without being decomposed, and may be again separated by an acid. Concentrated alkaline solutions render it brown, and decompose it, especially when affliated by heat.

When heated it becomes black without melting, exaltes frong acrid fumes, and leaves a charcoal, retaining exactly the form of the original mass. When distilled in clofe veffels it yields an acid liquor, of a peculiar taste and fmmell, called the pyr€ognes acif, and which was properly con- sidered as a diftinct acid. Fourcroy and Vaquelin, however, long ago demonstrated, that it consists of nothing but the acetic acid combined with an empymematic oil. (See Acetous and Pyrog-Trigoniues Acid.) Pure acetic acid is now prepared from wood both in this country and France.

The fibre of different woods has been analyzed by Gay Lussac and Thenard by means of the oxymuriate of potash. The following are the results:

<table>
<thead>
<tr>
<th></th>
<th>Oak</th>
<th>Beech</th>
<th>Mean.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxygen</td>
<td>41.78</td>
<td>42.73</td>
<td>42.25</td>
</tr>
<tr>
<td>Carbon</td>
<td>52.53</td>
<td>51.45</td>
<td>52.00</td>
</tr>
<tr>
<td>Hydrogen</td>
<td>5.69</td>
<td>5.82</td>
<td>5.75</td>
</tr>
</tbody>
</table>

100.00  100.00  100.00

Wood when burnt with a smothered flame leaves, as is well
The woody fibre, when completely burnt, always leaves a certain proportion of earthy and saline matters, which constitute the ashes of wood. Different woods yield very different proportions of ashes. See Ashes and Charcoal, where other experiments by Mr. Mifflin on this subject are related.

The following Table exhibits the quantity of ashes left by different woods, according to Sauvile junior. Sauvile has extended the investigation to herbaceous and other plants; but we have omitted thefe, from their not being immediately connected with the present subject. See Carbon.

### Table of Incinerations.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood of a young oak, May 10</td>
<td>- 4</td>
<td>-</td>
<td>26</td>
<td>28.5</td>
<td>12.25</td>
<td>0.12</td>
<td>1.0</td>
<td>32.58</td>
</tr>
<tr>
<td>Bark of ditto</td>
<td>- 60</td>
<td>-</td>
<td>7</td>
<td>4.5</td>
<td>63.25</td>
<td>0.25</td>
<td>1.75</td>
<td>22.75</td>
</tr>
<tr>
<td>Perfect wood of oak</td>
<td>- 2</td>
<td>-</td>
<td>38.6</td>
<td>4.5</td>
<td>32.0</td>
<td>2.0</td>
<td>2.25</td>
<td>20.65</td>
</tr>
<tr>
<td>Alburnum of ditto</td>
<td>- 4</td>
<td>-</td>
<td>32.0</td>
<td>24.0</td>
<td>11.0</td>
<td>7.5</td>
<td>2.0</td>
<td>23.5</td>
</tr>
<tr>
<td>Wood of black poplar, Sept. 12</td>
<td>- 8</td>
<td>26</td>
<td>-</td>
<td>16.75</td>
<td>27.0</td>
<td>3.3</td>
<td>1.5</td>
<td>24.5</td>
</tr>
<tr>
<td>Bark of ditto</td>
<td>- 72</td>
<td>-</td>
<td>6.0</td>
<td>5.3</td>
<td>60.0</td>
<td>4.0</td>
<td>1.5</td>
<td>23.2</td>
</tr>
<tr>
<td>Wood of hazel, May 1</td>
<td>- 5</td>
<td>-</td>
<td>24.5</td>
<td>35.0</td>
<td>8.0</td>
<td>0.25</td>
<td>0.12</td>
<td>32.2</td>
</tr>
<tr>
<td>Bark of ditto</td>
<td>- 62</td>
<td>-</td>
<td>12.5</td>
<td>5.5</td>
<td>54.0</td>
<td>0.25</td>
<td>1.75</td>
<td>26.0</td>
</tr>
<tr>
<td>Perfect wood of mulberry, November</td>
<td>- 7</td>
<td>-</td>
<td>21.0</td>
<td>2.25</td>
<td>56.0</td>
<td>0.12</td>
<td>0.25</td>
<td>20.38</td>
</tr>
<tr>
<td>Alburnum of ditto</td>
<td>- 13</td>
<td>-</td>
<td>26.0</td>
<td>27.25</td>
<td>24.0</td>
<td>1.0</td>
<td>0.25</td>
<td>21.5</td>
</tr>
<tr>
<td>Bark of ditto</td>
<td>- 89</td>
<td>-</td>
<td>7.0</td>
<td>8.5</td>
<td>45.0</td>
<td>15.25</td>
<td>1.12</td>
<td>23.13</td>
</tr>
<tr>
<td>Perfect wood of hornbeam, November</td>
<td>- 4</td>
<td>6</td>
<td>345</td>
<td>22.0</td>
<td>23.0</td>
<td>26.0</td>
<td>0.12</td>
<td>2.25</td>
</tr>
<tr>
<td>Alburnum of ditto</td>
<td>- 80</td>
<td>390</td>
<td>18.0</td>
<td>36.0</td>
<td>15.0</td>
<td>1.0</td>
<td>1.0</td>
<td>29.0</td>
</tr>
<tr>
<td>Bark of ditto</td>
<td>- 4</td>
<td>7</td>
<td>345</td>
<td>4.5</td>
<td>4.5</td>
<td>59.0</td>
<td>1.5</td>
<td>0.12</td>
</tr>
<tr>
<td>Wood of horse-chestnut, May 1</td>
<td>- 35</td>
<td>-</td>
<td>9.5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

See Dr. Thomson's System of Chemistry, vol. iv. 5th edit.

Wood, On making Bread from. Professor Autenrieth, of Tubingen, has lately attempted to make bread from wood, and his experiments seem to have been attended with considerable success. He had been led to form the opinion that the woody fibre was only rendered unfit for food from the foreign substances usually attached to it, and from its compact aggregation. The first of these difficulties he attempted to obviate, by selecting those woods which have little taste and smell, and which consequently contain less foreign matters; such, for example, are the birch and beech, especially the birch, which was the wood he chiefly employed in his experiments.

To render wood alimentary, it is necessary to reduce it to a state of extremely minute division, or absolute powder. It also requires the repeated action of the heat of an oven, by which means it is not only better fitted for being ground, but probably also undergoes some internal change which renders it more digestible, as is evidently the case in regard to coffee. Wood prepared in this way acquires the smell and taste of corn-flour. It is, however, never white, but always yellowish. It also agrees with corn-flour in requiring the addition of some leaven, to enable it to undergo the fermentative process, and the flour leaven of corn-flour is found to answer the best. With this it makes a perfectly uniform and spongy bread, like common brown bread; and when it is thoroughly baked, and has much crust, it has a much better taste of bread than what in times of scarcity is prepared of bran and husks of corn.

To make wood-flour in perfection, the wood, after being thoroughly dried of its bark, is to be softened transversely into disks of about an inch in diameter. The saw-dust is to be preferred, and the disks to be beaten to fibres in aounding-mill. The fibres and saw-dust mixed together are next to be deprived of everything harsh and bitter, and which is soluble in water, by boiling them in a large quantity of water when fuel is abundant, or by subjecting them for a longer time to the action of cold water, as by placing them in a rivulet, for example, enclosed in a sack. The whole is then to be completely dried, either by the sun or fire, and repeatedly ground in a flour-mill till it passes through the bolting-cloth.

The ground wood is next to be baked into small flat cakes, with water rendered slightly macerulugious by the addition of some decoction of linseed, or any other similar substance. Professor Autenrieth prefers marsh-mallow roots, of
WOOD.

of which one ounce renders eighteen quarts of water sufficiently mucilaginous, and thence serve to form four pounds and a half of wood-flour into cakes. These cakes are to be baked in an oven until they are quite dry, and become of a brownish-yellow colour on the surface. After this they are to be broken to pieces, and again ground repeatedly, until the flour passes through a fine bolting-cloth, and upon the fineness of the flour does its fitness to make bread depend.

The flour of a soft wood, such as birch, will be sufficiently prepared by the process as described; but the flour of a hard wood will require the steps of baking and grinding to be repeated.

That the wood thus prepared is altered in its nature and rendered soluble, is proved by the quantity of real starch that is obtained from it by the same process, by which it is separated from wheat-flour. If wood-flour tied up in fine linen be long kneaded in a vessel of water, the water is rendered milky, and deposits slowly a quantity of starch, which with boiling water forms a thick, tough, trembling, tenacious jelly, like that of wheat-starch, and it is only necessary to see this starch to be convinced that the wood-flour is soluble and nutritious. This starch cannot be ascribed to the mucilaginous matter added to the ground wood before it is baked, as the added mucilage does not amount to more than the one-hundred and fifty-fifth part of the wood, whereas the wood-flour loses about half its weight by the separation of the starch. The residuum left in the linen seems to be the woody fibres unchanged, which have not been ground sufficiently fine.

Wood-flour does not ferment so readily as wheaten-flour; but professor Auenreith found fifteen pounds of birch-wood flour, with three pounds of four wheat leaven, and two pounds of wheat-flour, mixed up with eight measures of new-milk, yielded thirty-six pounds of very good bread.

The best mode of preparing it was to mix up the five pounds of wheat leaven and flour with a portion of the wood-flour and milk to a preparatory dough; let it stand for some hours in a moderately warm place to rise, and then knead in thoroughly the rest of the wood-flour and milk. This dough is rolled out into thin cakes, allowed to stand in a warm place to rise for a longer time than wheat-flour requires, and lastly to be put into the oven and baked thoroughly.

Professor Auenreith made many experiments upon animals, as well as upon himself and family, in order to ascertain the nutritious properties of wood-flour, in the various forms of soup, dumplings, cakes, &c.; and he found that it was not only very palatable in all these forms (especially when combined with milk or some fatty substances), but also sufficiently nutritious, and that it did not disorder the digestive organs, or apparently produce any other ill effects.

From these experiments, it is obvious, says the writer from whom we have made these extracts, that in cases of necessity wood may be made to furnish a considerable quantity of nourishment; but it is not less obvious, that the process is so troublesome and expensive, that it never can become an article of food, except where there is an absolute scarcity of provisions. On such occasions the labour is of very secondary importance, and at any rate cannot be so profitably applied as in procuring the means of subsistence.

In some districts of Norway and Lapland, the bark of the fir is manufactured into a species of bread, apparently much inferior in quality to the bread of wood-flour, and this with dried fish and a little rein-deer tallow constitute the chief articles of food among the lower classes, during the protracted and rigorous winter of these inhospitable climates. See Von Buch’s Travels in Norway and Lapland.

WOOD, Diftillation of. See Charcoal, Colour, Gun-Powder, Pyrrolunteous Acid, and Wood-supra.

WOOD, Tenacity and Strength of. See Cohesion and Strength of Materials.

WOOD and Wood, a term in ship-building, implying that when a tree-nail, &c. is driven through, its point is directly even with the inside surface, whether planked or timber.

WOOD, Cord, denotes wood for the fire, generally the branches or loppings of trees, piled up in order. See Cord.

WOOD, Fossil, Subterraneous. There are divers places where wood is found under ground: supposed to have been over-turnd, and buried there from the time of the Deluge, or at some other period.

Whole trees, or parts of them, are very frequently found buried in the earth, and that in different strata; sometimes in stone, but more usually in earth; and sometimes in small pieces loose among gravel. These, according to the time they have lain in the earth, or the matter they have lain among and in the way of, are found differently altered from their original state; some of them having suffered very little change, and others being so highly impregnated with crystalline, sparrey, pyritic, or other extraneous matter, as to appear mere medleys of stone or lumps of the common matter of the pyrites, &c. of the dimensions, and more or less of the internal figure of the vegetable bodies, into the pores of which they have made their way.

The fossil wood, which we find at this day, may, according to these differences, be ranged into three kinds: 1. The leaf altered. 2. The pyritic. And, 3. The petrified.

Of the trees or parts of them left altered from their original state, the greatest store is found in digging to small depths in bogs, and among what is called peat or turf-earth, a subsistence used in many parts of the kingdom for fuel. In some places there are whole trees fearfully altered except in colour; the oaks in particular being usually turned to a jetty black: the pines and firs remain as inflammable as ever, and often contain between the bark and wood a plain resin. Parts of trees have been also found unaltered in the strata of clay and loam, among gravel, and sometimes even in solid stone. See Fossil Plants, and Bog Wood.

It is idle to imagine, that these have been thus buried either at the Creation, or, as many are fond of believing, at the universal Deluge: at the first of these times the strata must have been formed before trees were yet in being, and the peat wood is so far from being of antediluvian date, that much of it is well known to have been growing within thes three hundred years, in the very places where it is now found buried. See Morass.

The substances that are more altered are the larger and longer branches of trees found bedded in the strata of stone, and partly assuming its nature; and the shorter and smaller branches found in pits of blue clay, which externally bear the resemblance of what they once were, but, having their pores filled with the matter of the common vitriolic pyrites, internally appear to be mazes of that matter.

The irregular mazes or fragments of wood are principally of oak, and most usually found among gravel, but variously altered by the infumation of crystalline and strong particles. These make a beautiful figure when cut and polished, as they commonly keep the regular grain of the wood, and show the several circles which mark the different years growth. These, according to the different matter which has filled their pores, assume various colours, and the appearance of the various fossils that have impregnated them. Of these some pieces have been found with every pore filled with
with pure pellucid crystal, and others in large masses, part of which is wholly petrified, and some mere stone, while the rest is crumbly and unaltered wood.

All these pieces of petrified wood are usually capable of a high and elegant polish. Hill.

Wood has been found in salt-mines, enclosed in a mass of hard salt, and its pores filled with the matter of the salt in which it lay. Wood has likewise been found converted as it were into iron, or thoroughly impregnated with the particles of this metal. Aft. Erud. ann. 1710.

Wood, Petrified. The opinions of the judicious part of the world have been very different in regard to the bodies preferred in the cabinets of the curious, under the name of petrified wood; some affirming these bodies to have been only pebbles, or flints accidentally formed in this shape, and with veins resembling those of the wood; and others affirming with equal warmth, that they have been really wood, into which stony matter has been brought by water.

Many substances, it is certain, have been preferred in the cabinets of collectors, under the title of petrified wood, which have very little right to that name. But where the whole outer figure of the wood, the exact lineaments of the bark, or the fibrose and sullen texture of the fraxia, and the vestiges of the uricula and trachea or air-vessels are yet remaining, and the several circles yet visible, which denote the several years growth of the tree, none can deny such substances to be real fossil wood.

Many good arguments have been produced on both sides the question, but M. de la Hire has attempted to bring the dispute to a certain conclusion, by means of some peculiarly happy specimens, which were of the palm-tree petrified, found in the deserts of Africa: these on comparing them with pieces of the palm-tree cut out of the recent wood, appeared to have every where the beautiful and regular veins of that wood, and left no room to doubt but that they certainly had been once the vegetating wood of that tree, though now converted into hard stone; the petrified pieces were perfect stone, in all its qualities; they had its hardness, its found when struck upon, and were, as many other stones are, opaque in some places, and transparent in others; they were found on weighing them to be often of the specific gravity of recent pieces of the palm wood of the same dimensions.

Father Duchat also, an author of unquestioned credit, affirms, from his own personal knowledge, that in the kingdom of Ava there is a river whose waters petrify recent wood into flint; and that he has often seen trees standing in it, whose bottom part, so far as covered with the water, has been true flint, while all above was mere dry wood, and fit for firing. Mem. Acad. Par. 1692.

Wood, Shining. There are a great many things in which a piece of rotten wood that shines in the dark agrees with a burning coal; and there are also many things in which they differ. They agree in these particulars: 1. They have light relieving in them, and are not like bodies which are only luminous according to the quantity of light which falls upon them from other bodies, and which they reflect. 2. Both shining wood and burning coals require the presence of the air to keep them shining, and both require also an air of a considerable density; and both having been deprived of their shining quality by the pumping out of the air, will recover it again on the admitting of fresh air to them. 3. Both of them will easily be quenched by putting them into water, and many other liquors. And, 4. As a live coal will not be extinguished by any coldnefs of the air, neither will the shining wood be deprived of its light on any additional coldnefs in that element.

However, they differ in the following particulars: 1. A burning coal is easily put out by compression, the treading on it and squeezing it together readily diverting it of its light; on the other hand, compression or crushing of any kind seems not to have any effect upon the shining wood; its bruised parts shining as brightly as its entire ones. If a piece of this shining wood be squeezed between two glasses, this experiment will be most fairly tried; and in this case, though the contexture of the whole be evidently broken, and the parts separated, the light is as strong in them as while the piece was entire. 2. A burning coal extinguished by the drawing out of the air will, after a few minutes, be irrecoverable, on the admission of air in any manner; but, on the contrary, the shining wood, when thus extinguished and kept extinct for half an hour, will be immediately re-kindled on admitting the air to it. 3. A live coal, included in a small glass, will continue burning but a few minutes; but a piece of shining wood, in the same circumstances, will continue bright for several days. 4. The coal, while it burns, sends forth smoke and other exhalations; the rotten wood sends out none, and consequently a coal all the while that it is shining wanles itself at a great rate; but the rotten wood does not waste itself at all. And finally, the burning coal is actually and vehemently hot; the rotten wood, though it shines, is not so much as warm. Phil. Trans. N° 32.

The light of shining flesh and fift, when petrified, is wholly of the fame nature with that of rotten wood, as to its dependence on the air for its splendour; and in the fame manner lofes its light in the exhausted receiver, and regains it on the admission of the air into it again, in the fame fudden manner. Phil. Trans. N° 31. See Light, and Reflection.

Wood, Bog, or Subterraneous, a name given by the inhabitants of many parts of this kingdom to fuch wood as is found buried in the earth in boggy places, and which is found hard and strong at this time. See Fossil Wood supra.

We have in the Philosophical Transactions (N° 275, p. 983, &c.) an account of vaft quantities of this f ort of wood found under ground in Hatfield Chase. Many of the roots and bodies of trees are found there; which are of all growths, and are molluy fuch trees as are the growth of our own foil, fuch as oaks, firh, birch, beech, yew, holly, willow, agh, and the like. The roots of all these trees land in their natural poftitions as when growing, and land as thick together as they could grow in a foffet. The bodies are utterly broken off, and laid all along jurt by them.

The large trees are usually found fallen in a north-eaft direction, and the smaller ones lying all ways; the fir-tree or pitch-tree is more common than any other kind, and is found fometimes of twenty, thirty, and thirty-five yards long, and fo found and firm that many of them have been fold to make mills for ships. Oakes have been found of the fame length, though wanting fome yards of their natural tops; thefe have been fold at ten or fifteen pounds a piece, and are as black as ebony, and very found and lafting in whatever service they are put to. The all-trees do not preserve their firnnefs in this manner, many of them are fo loft that the workman's fpade cuts through them; and when expoefed to the air, they usually fall to pieces; but the willows, though a much lofter wood than the agh, prefervr their texture, and are found very strong and firm. In some of the fir-trees it is very observable, that they have shot-
outside branches after they were fallen, which have grown into large trees. Many of these fossil-trees appear plainly to have been burnt; the fir-trees are particularly very common in this state; and of these some are burnt quite through, others only on one side. Some of these also have been found with the plain marks of human work upon them; many with their branches chopp’d off, and their trunks cut into two or three pieces. Some squared and others in part cleft, and the wooden wedges used in cleaving them are still found remaining in the cracks. Stones are found in some of them in the place of wooden wedges, but in none iron ones. The heads of axes are also sometimes found; they are of a strange form, and somewhat represent the sacrificing axes of the ancients. These are found at such depths, that it is impossible they should have ever been lodged there since the time of this place’s being a forest; nor ever could have been found, but by means of the ground’s being drained by a late invention. The general opinion as to these trees is, that they were buried in this manner at the time of the universal Deluge; but they are plainly of later origin as fossils, the coins of some of the Roman emperors having been found buried under them.

The earth of bogs is not the only foil that preserves these trees; for in the low parts of Lincolnshire, between the towns of Burningham and Bramley, there are several large hills composed only of loose sand, and as this blows away there are continually discovered whole trees, or parts of trees, and particularly the roots and stumps of firs, and some other kinds, all with the marks of the axe upon them, and looking as fresh as if done but yesterday. Under these hills, and in the bosks before-mentioned, not only the wood of the fir-tree, but its cones are found in immense number; many bulks being often laid in a heap together. In cutting a drain for a river of a considerable depth, there were found at the very bottom several parcels of cut wood, in poles, beams, and the like; the head of an axe was also found somewhat resembling the ancient battle-axe, and a coin of the Roman emperor Verus; but what was yet more remarkable was, that what they were now sunk to seemed to be the original surface, the ground not being loose, like all above it, but found firm, and lying in ridges and furrows, with the evident marks of having formerly been ploughed. So that all the bog-earth above seems plainly to have been added since; and that the fossil wood, supposed of antediluvian origin, is but of the time of the ancient Romans, or less than that.

All the bogs in this kingdom afford in like manner fossil-trees; and not only thole, but other places, have at all times accidentally discovered them. Giraldis Cambrensis tells us, that so long since as in king Henry the Second’s time, the fands on the shores of Pembroke-shire were driven off by peculiar storms and tempests, and that deep under those sands there were then discovered great numbers of the roots and bodies of trees in their natural postures; and many of those had the strokes of the axe upon them, the marks at that time remaining as plain as when first made. Some of those resembled ebony; and many other such trees were discovered at Newgall in the same county, in the year 1590. Camden tells us of such wood found in the bogs in Somersetshire, Cheresh, Lancashire, Westmoreland, Yorkshire, Staffordshire, and Lincolnshire; and since his time many other counties have been found to be as fruitful in it. Dr. Plot mentions them in many parts of his History of Staffordshire, and by their standing in their natural postures, as to the roots at leaf, properly concludes, that they certainly once grew there, and were not brought from elsewhere.

Dr. Leigh, in his History of Lancashire, gives an account of the same sort of trees found in the draining of the boggy lands at Martin-Meer; and determines them not to have been of the ancient date many pretend, in referring them to the Deluge.

He observes, that they are plainly of no older date than the time of the savage inhabitants of England, about the time of the Roman conquests; for in this place, beside the roots and bodies of trees and their fruit, there were found eight canoes, or small boats, such as the wild inhabitants used at that time. And in another moor in the same county, a brafs kettle, with a small mill-flone, and some beads of wrought amber. In the same place were also found several human bodies whole and entire, at least to outward appearance, and the whole head of an hippopotamus, or river-horse. This is perhaps the hardest thing to be accounted for of the whole set, as to its coming there. The boggy places in Anglesea, and the Ile of Man, are all full of buried trees of the same kind; and the bogs of Ireland abound no less with them. England, and its adjacent islands, are not the only places where this buried wood is found; for Vertegau tells us, that the moors in the Netherlands abound with them; they all lie north-east, as our’s do. Hclmont also mentions the Peell there, a morafs of eight or nine miles broad, which is full of them. The French naturalists tell us of fossil-trees also in their country; and in Switzerland and Savoy; but all in the low grounds.

Ramazzini tells us, that in the territories of Modena, which are now a dry and fruitful country, yet in the time of the Caesars were only a great lake, there are found at the depth of thirty, forty, and even fifty feet, the foil of a low marthly country, with fedges, water-grafs, and other marsh-weeds; and under this there lie the trunks of trees, and their roots stand near them in the ground as natural a posture as when growing. Many old coins of the Roman emperors are also found there; as also several butt’s, wrought marble, and squared flones, evidently shewing the work of such tools as the Romans have been known to use. Some of the trees in these places stand upright. See more on this subject under the article Morass.

Wood, Cutting of. See Cutting.
Wood, Measure of. See Measure.
Wood, Stack of. See Stock.
Wood, Staining of. See Dyeing of Wood, &c.

Wood may be stained yellow, by bruising it over several times with the tincture of turmeric root, made by putting an ounce of the powdered root to a pint of spirit, and after it has stood some days, straining off the tincture. A redder cast may be given to the colour by adding a little dragon’s blood. A cheaper, and less bright and strong yellow may be given to wood by rubbing it over several times with the tincture of French berries, made boiling hot; and when the wood is dry, bruising it over with a weak alum-water ured cold.

In order to render these stains more beautiful and durable, the wood should be bruised after it is coloured, and then varnished with the seed-lac varnish, or with three or four coats of shell-lac varnish.

For a bright red stain for wood, make a strong infusion of Brazil in stale urine, or water impregnated with pearls in the proportion of an ounce to a gallon; to a gallon of either of which add a pound of the Brazil wood. With this infusion, after it has stood, with frequent stirring, two or three days, strained and made boiling hot, bruise the wood over till it appears strongly coloured; and while it is wet, bruise it over with alum-water.
water made in the proportion of two ounces of alum to a quart of water.

For a less bright red, brush over the wood with a tincture made by dissolving an ounce of dragon’s blood in a pint of spirit of wine.

For a pink or rose red, add to a gallon of the above infusion of Brazil wood three ounces of pearl-ashes, and use it as before: observing to brush the wood over often with the alum-water. These reds may be varnished as the yellows.

Wood may be stained blue by means either of copper or indigo. The brighter blue may be obtained by brushing a solution of copper (see Verditer), while hot, several times over the wood; and then brushing a solution of pearl-ashes in the proportion of two ounces to a pint of water over the wood. It is stained blue with indigo, by brushing it with the indigo prepared with soap-leaves as when used by the dyers, boiling hot; and then with a solution of white tartar or cream of tartar, made by boiling three ounces of either in a quart of water, brushing over the wood plentifully before the tincture of indigo be quite dry. These blues may be brushed and varnished as the reds, if necessary.

Wood may be stained green by dissolving verdigris in vinegar, or the crystalline of verdigris in water, and with the hot solution brushing over the wood till it be duly stained.

A light red-brown mahogany colour may be given to wood by means of a decoction of madder and fustic wood, ground in water, in the proportion of half a pound of madder and a quarter of a pound of fustic to a gallon, or, instead of the fustic, an ounce of the yellow berries may be used. Brush over the wood with this solution, while boiling hot, till the due colour be obtained. The same effect may to a considerable degree be produced by the tincture of dragon’s blood and turmeric root, in spirit of wine.

For the dark mahogany, take the infusion of madder as above, and substitute for the fustic two ounces of logwood: and when the wood has been brushed over several times, and is dry, brush it over slightly with water in which pearl-ashes have been dissolved, in the proportion of about a quarter of an ounce to a quart. The wood, in the better kind of work, should be afterwards varnished with three or four coats of seed-lac varnish; but for coarse work, with the varnish of resin and seed-lac, or they may be well rubbed over with drying oil.

Wood may be stained purple by brushing it over several times with a strong decoction of logwood and Brazil made in the proportion of one pound of the logwood and a quarter of a pound of the Brazil, to a gallon of water, and boiled for one hour or more. Let the wood, well coloured, dry, and be then slightly passed over by a solution of one drachm of pearl-ashes in a quart of water. A solution of gold in spirit of falt or aqua regia will give a durable purple stain to wood.

For a deep black the wood is brushed over four or five times with a warm decoction of logwood, made as above without the Brazil, and afterwards as often with a decoction of galls, made by putting a quarter of a pound of powdered galls to two quarts of water, allowing it to dry thoroughly between the several applications of the liquors: thus prepared, it receives a fine deep-black colour, from being washed over with a solution of vitriol in the proportion of two ounces to a quart: in the room of which some use a solution of iron in vinegar, keeping the vine-

gar for this purpose upon a quantity of the filings of the metal, and pouring off a little as it is wanted. A pretty good black is also obtained, more expeditiously, by brushing over the wood, first with the logwood liquor, and afterwards with common ink.

A very fine black may be produced by brushing the wood several times over with a solution of copper in aqua fortis, and afterwards with the decoction of logwood, repeated till the colour be of sufficient force, and the greens produced by the copper overcome. The blacks may be varnished as the other colours.

Where the stains are desired to be very strong, as in the case of wood used for fineering, it is generally necessary it should be soaked, and not brushed; for which purpose the wood may be cut into pieces of a proper thickness for inlaying. Lewis’s Phil. Com. Techn. p. 97. 434. Handmaid to the Arts, vol. i. p. 508, &c.

Wood, Stealing of. See Larceny.

Wood, Engraving on. See Wood-Engraving, infra.

Wood, Painting on. See Painting.

Wood, Sculpture in. See Sculpture.

Wood, Sylva, in Geography, a multitude of trees, extended over a large continued tract of land, and propagated by nature, or without culture.

Many great woods only confit of trees of one kind. At Cape Verd, in Africa, are woods of orange and lemon trees; in Ceylon, are woods of cinnamon-trees; in the Molucca islands, woods of clove-trees; in the islands of Nero, Lontour, Loafgrain, &c. woods of nutmeg-trees; in Brazil, woods of Brazil-trees, &c.; in Numidia, woods of date-trees; in Madagascar, woods of tamarind-trees, &c.

Wood-Ashes, in Agriculture, the ashes which are formed by burning wood.

The ashes of some sorts of wood, too, are found to be more powerful as a manure than those of others, as those from the ash and some other fuch trees.

It is said by some that they are an excellent dressing for improving cold wet pature land; and that poor hungry pastures have been very profitably benefited by them, to near double their former value; that nothing equals them on low spongy pature land. Others, however, have tried them on grafs-lands with little or no effect.

The difference in the burning and forming of them may probably cause this difference in the effects which they have on land.

Wood-Bound, a term used to signify such land as is encumbered with tall woody hedge-rows, so as to prevent the free circulation of air and admission of the sun, by which the natural fertility and strength of it cannot be fully exerted or brought into action. See Wood-Land.

Wood-Coppices. In the first raising of coppices, two things are to be considered; fift, the nature of the soil, that such trees may be planted in it as will thrive well there; and secondly, the uses that the wood is intended to be fold for, that such kinds may be planted as will be most proper for those ufses.

If the principal vent for wood be for the fire, the beft trees for fire-wood must be planted, such as the oak, beech, hornbeam, or other hard wood. These are the most profitable for selling as fire-wood, and one or more of these grow in any foil.

If there be a demand in the country where the coppice is to be planted for hoops and hop-poles, then the ash, the chesnut, the oak, alder, and hazel, are to be planted.

According
According to the profits of the underwood, the thickness of the standard-trees is to be regulated; for as they stand more or less thick, they more or less injure the underwood. It is also to be considered, at what growth the underwood is to be felled. The taller and larger the underwood of a coppice in general is, the more profitable will it be for firing, and all other uses, and the standards will be the better for its being left to grow to a proper height, for their bodies will be always, unless very great accidents occur, carried up straight as far as they are shaded by the coppice-wood.

A deep foil makes the shrubs as well as trees grow more vigorously than any other, and they will be sooner fit for cutting in such places. The person who owns these woods must contrive to cut down only a certain quantity of them every year, and regulate this so that he may have a constant succession of a like quantity; that part of the wood which was at first felled, may be grown up to its size for felling again by the time the last is cut. This is, in different places, to be calculated to all the various numbers between eight years and twenty or thirty.

The cutting of wood seldom yields the more and the better timber; but the cutting of it often has greater advantages, in that it makes it grow thicker, and gives the feedlings time to come up. If many timber-trees grow in the coppice, and are to be cut down, they and the underwood should be felled together, cutting off the stumps as close to the ground as may be, in the trees, and in the shrubs and underwood the stumps should be left about half a foot high, and cut flating and very smooth.

Sawing is the best method of felling timber-trees; but it sometimes kills the root; and if this is observed to be the case in the coppice, no new stumps arising from the root, then it is proper to fblb up the root, that it may not unneceffarily encumber the ground, and that the other young plants may have the benefit of it.

In the first raffing of coppices from feed, the ground must be prepared by good tillage, as much as if it were intended for corn. The fees of the several trees are to be fown in February, and if the foil be shallow, the ground should be ploughed into great ridges; this will make the foil lie thicker on the top of each ridge, by which means the roots will have more depth to run to for nourishment, and in a few years the furrow will be filled up to the level of the ridl with the dead leaves; and these, as they rot at the bottom, will make a kind of foil, through which the young stumps will spread, and be conducted from one ridge to another, and fo the whole ground will be occupied by them. If the coppice be to be raised on the side of a hill, plough the ridges cros-way of the defect of the hill, that the water may be detained among them, and not suffered to run off, as it otherwise would by the furrows; but if it happen that the ground be over-wet, which is more rarely the case, then the contrary method is to be observed, and the furrows ploughed deep and straight downwards, that all water may be carried off by them, as by so many trenches or drains.

Some few a crop of corn along with the fees of the underwood, for the advantage of the firt year; but as the feafon of fowing the fees of the trees is too late for the fowing of the corn, it seldom turns to much advantage. It is better to fow the trees alone, and keep them well weeded the two firt years; after which they are strong enough to take care of themselves against such enemies.

In very barren ground, where the young trees can hardly fland the heat in fummer, it is proper, after fowing them, to fatter a quantity of furze-feed over the land; the furze will grow quick, and over-top the trees at firft, but it will serve as a guard to them at this time, defending them from injuries, and keeping the ground moist about their roots. In a few years the trees will grow up beyond these bushes, and they will then foon destroy them by their dropping.

In the raffing of coprcees, the nearest distance for the plantations ought to be five feet for the underwood, but as to what number, and scantlings of timber are to be left on each acre, the statutes in this cafe direct; but it is an ordinarv coppice, which will not afford three or four firks, fourteen seconds, twelve thirds, and eight wavers, according to which proportion the fizes of young trees in coprcees are to fucced one another. In coprce or underwood felled at twenty-four years growth, there are to be left twelve flore-oaks upon every acre, or, in defcit of them, the fame number of elms, beeoh, or ash: these are to be straight-bodied trees, and are to be left till they are ten inches in diameter, at a yard from the ground; but it is better for the owner to have a much greater number of timber-trees, especially in places where underwood is cheap; and as to the felling, it is always neceffary to begin regularly with one fide, that the carriages, necefary to taking off the wood, may come on without injury to the reft; and in large woods, the cart-way should always be left in the middle, quite through the wood. The timber of the underwood may be cut from the month of October to February; but the laft month is much the belt, in places where there is but a small quantity to be felled, and it can all be got down before the fpring is too much advanced. All the wood fould be carried out by Midsummer, and made up by April at the latest; for when the rows and bruff hie longer than this unmade up, and unbound, many of the stumps and feedlings are spoiled by them. It is always worth the owner's while to inclufc the coppice well the winter before felling, to keep out the cattle, which would else greatly damage the fupply from the feedlings and young stumps.

New-weaned calves are the leat prejudicial to newly cut woods of any creatures, and may be put in where there is much grafs; the next in harmlefsnes to these are young colts, which, at about a year old, may be put in to feed in the fame manner; but about May they must all be put out.

If the woods happen to be cropped by cattle, it is best to cut them up, and they will make new stumps; for that which has been bitten by the cattle will not grow for several years in any degree.

If the coppice-woods are too thin, this is to be remedied by laying down the longeft and intermediate stumps of those shrubs or trees which are the most advantageous, in the place, or of such as are nearest the bare place; these will each fend forth a great number of suckers, and the whole wood will be thickened as much as desired in a very little time. Mortimer's Husbandry, vol. ii. p. 64. See COPPECE.

WOOD, Almigim. See Almigim.
WOOD Anemone. See ANEMONE.
WOOD-Bine, or Wood-bind, in Botany, a species of lonicera; which fee.
WOOD-Bind, Spanish, a species of ipomeca; which fee.
WOOD-Chot, in Ornithology, lanius minor primus of Al-}

{black
black line drawn across the eyes, and then downwards on each side the neck; the head and hind part of the neck are: of a bright bay; the upper part of the back dusky; the covert of the tail grey; the bec pad ultra white; the covert of the winga dusky; the quill-feathers black, having a white spot at the bottom; the throat, breast, and belly of a yellowish-white; the legs black. In the female, the upper part of the head, neck, and body, are reddish, tinted transvertely with brown; the lower parts of the body are of a dirty white, rayed with brown; the tail of a reddish-brown, marked near the end with dusky, and tipped with red. Pennant.

Wood-Cock, Scolopax rusticola of Linnæus, called by other writers La becbeau, a well-known bird distinguished by its size, which is somewhat smaller than that of the partridge, and by its colour, which is on the back a variety of black, grey, and a reddish-brown; on the forehead the black predominates; the quill-feathers are dusky, indented with red marks; and on the belly a pale grey, variegated with transverse streaks of brown. Its beak is three inches long, dusky toward the end, and reddish at the base, and the upper chaper a little longer than the under; the tongue slender, long, sharp, and hard at the point; the eyes large, and placed near the top of the head, that they may not be injured when the bird throws its bill into the ground: from the bill to the eyes is a black line; the forehead is a reddish, ash-colour; the chin is of a pale yellow; the tail consists of twelve feathers, dusky or black on the one web, and marked with red on the other; the tips above are ash-coloured, below white: the legs and toes are livid, the latter divided almost to their origin, having only a very small web between the middle and inner toes.

These birds, during summer, are inhabitants of the Alps, Norway, Sweden, Polih Frussia, the Mark of Brandenburg, and the northern parts of Europe; whence they emigrate at the approach of winter into milder climates, where the ground is open and adapted to their manner of feeding. The time of their appearance and disappearance in Sweden coincides exactly with that of their retreat from and arrival in Great Britain. They live on worms and insects, which they search for with their long bills in soft ground and moss woods. They generally arrive here in flocks, taking advantage of the night or a mist; they soon separate: but before they return to their native haunts, pair. They feed and fly by night; beginning their flight in the evening, and returning the same way to their day-retreat.

They leave England the latter end of February, or beginning of March; though they have been known to continue here accidentally. In Welford, near Northbridge, a few breed almost annually. During incubation they are very tame. They come over to the coast of Suffolk sparingly in the first week of October, the greater number not arriving till the months of November and December, and always after fun-fet. They are determined in their flight by the wind, and arrive separate and dispersed. When the red-wing appears on the coast in autumn, the wood-cocks are at hand; and when the Reydon crow is arrived, they are come. Between the 12th and 25th of March they flock towards the coast to be ready for their departure, having the red-wings for their harbingers in spring, as in autumn. If the wind be favourable, they immediately depart; but otherwise, they are detained in the neighbouring woods, or among the ling and furze on the coast: as soon as a fair wind springs up, they are suddenly gone.

In the same manner they are known to quit France, Germany, and Italy; making their northern and cold situations their general summer rendezvous. In the winter they are found as far south as Smyrna and Aleppo, and also in Barbary; and some have appeared as far south as Egypt, which seems to be the limit of their migration in that way. In Japan they are found very common. Those that reft in the countries of the Levant probably come from the deferts of Siberia or Tartary, or the cold mountains of Armenia.

Our species of wood-cock is unknown in North America; but they have a sort of wood-cock resembling ours in its general appearance; about half its size, and wanting the bars on the breast and belly. Pennant.

They hate flying high, and are afraid to fly among trees, because, like the hare, they fee but very badly straight before them; and it is owing to this imperfection in their flight, that they are so easily taken in nets spread in their places of resort.

The draw-net, in countries which are very woody, is extremely profitable in this sport, it being no uncommon thing to take ten or a dozen wood-cocks at a time in it.

There is another method of taking these birds in high woods, with those nets called hays, of the nature of the rabbit-hays, only with smaller meshes. The wood-cocks are to be driven into these, and there should always be at least two or three of them planted together. When the sportsman has provided himself with nets, he is to take five or six persons with him. The proper woods for this purpose are those of seven or eight years' growth; and the people are to go into some part of them near the middle. The nets or hays are to be placed in the same manner as they are for taking of rabbits, but two or three joining together at the end, and hanging over a flopewife that way which the wood-cocks are intended to be driven.

The nets being thus fixed, let the company go to the end of the wood, placing themselves at about ten rods distance from one another; they must all have flocks in their hands, and they are to move forward slowly towards the nets, making a noise by striking the sticks against the trees and branches, and by halloving with their voices; in this manner they are to move up to the net; and the wood-cocks that part of the wood will all be terrified before them, but will not take wing, but run along upon the ground, and be driven along like a drove of beasts, so that when the company come up, they will find almost all of them in the net. When that part of the wood is thus driven, the nets are to be turned the other way, and placed flopewise in the contrary direction, and the company retiring to the other end of the wood, are to drive the wood-cocks that are in that part with the same noise, till they have sent them into the nets in the same manner.

Thus all the wood-cocks in the wood may be taken with very little trouble, and this may be done equally at any time of the day.

Another way of taking this bird is by means of noozes or springes.

The wood-cock and the snipe are both easily taken with bird-line, when their places of resort are known, but they are not so easily found as many other birds.

The custom of the wood-cock is usually to be upon the banks under hedges, and by the sides of ditches toward the sun; and they will suffer the sportsmen to come nearer them in the day-time after a moon-shiny night, than after a dark one. The reason of which is, that having fed well by moon-light, they are only fit for rest the day following; but
but when the night has been dark, they are seeking food all day long. The snakes naturally lie by the sides of rivers, when the plashes and ponds are frozen, and they always lie with their heads up or down the stream, never transversely. In order to take either of these birds by bird-lime, the sportsman must be provided with a large number of small and smooth twigs, neatly and evenly covered with good bird-lime. There must be placed a slope, some one way, some another, and the whole place about where they rest must be covered with them. The sportsman then must conceal himself very carefully, that the sight of him may not frighten away the game. See Cock-Road.

**Wood-Cock Apple**, in *Rural Economy*, a fine cyder fruit. See Apple-Tree.

**Wood-Cock Shell**, a name given by the English naturalists to a peculiar kind of the purpura. It is called in French, *becafte*, from the length of its beak. There are two species of this, a prickly and a smooth one.

The prickly kind is an extremely beautiful and elegant shell. It is of a yellowish colour; and its tail or beak (for the hinder extremity of the shell, which runs out into an immense length, is sometimes called by the one, sometimes by the other of these names) is furnished with four rows of large and very long spines: between the rows of these, there are also rows of small and short spines. The body of the shell is furrowed very deep, with a number of transverse circular lines; and both this and the clavicle are befit with several rows of long spines.

The smooth becafe, or wood-cock shell, is a very elegant species, but much less so than the other. It is of a yellowish colour, radiated with black and grey lines. It is all over deeply furrowed, and the ridges are befit with tubercles, the clavicle is elevated, and the tail extremely long, and hollowed into a sort of tube. The mouth of this, as well as of the other, is small and roundish, and in this species is of a light flesh-colour.

**Wood-Cock Soil**, in *Agriculture*, a term applied to such land as has the mould of a dapple-brownish colour, and which is said not to be of a good quality for many purposes. See Soil.

**Wood-Corn**, a certain quantity of oats, or other grain, anciently given by customary tenants to their lord, for the liberty to pick up dead or broken wood.

**Wood-evil, or Cramp in the Leg**, a disease among sheep, which is so named in consequence of its being supposed in general to arise from the dripping of trees in cold and wet weather. It flows itself by leision the legs of the sheep, and making them totally incapable of walking; and will sometimes ail at once spread through the whole flock.

In regard to the means of cure, a tea-fpooof the flour of mustard has been advised to be given every night and morning. The affected parts should also be well rubbed with warm flannel, and the fleece be kept dry, which are very effectual aids. The use of a little oil of turpentine externally may also be advantageous, where the other mode of rubbing does not succeed: and in bad cases the use of mild mercurials with opium may be had recourse to with much benefit.

**Wood-Fuel, Saw for cutting of**, in *Rural Economy*, a tool used for this purpose. On the continent they employ an improved instrument of this kind, the iron part of which consists of a faw, three inches in breadth, and fourteen inches in length, double toothed, in the manner of the gardener's pocket saw, and fixed in a frame of tough ash-wood, as below. The edge part of the saw is made broader than the back, in order that it may work more freely and with greater ease.

The frame of the faw at the top part has a strong cord tied round each side of it, so as to tighten the faw and keep it from bending, being capable of being twitted tighter by a small thin piece of wood put between the double cord, and which may be kept from untwitting by being retled against the cross-bar in the upper part, which is mortified and firmly fastened into the two side pieces, being the only means that keeps the frame together in a safe manner. The side pieces are each twelve inches in length; and the additional length of the handle part of one of them five inches. It is evident that this faw will, on the principle of leaffening friction, and of keeping the cutting part from bending, work with much greater facility and expedition than the common carpenter's faw.

With this wood-faw twice as much work may be done in a day as with the common hand-faw that is in general use in this country.

**Wood-Geld**, *Woodgeldum*, in our ancient customs, the gathering or cutting of wood within the forest. Or it may denote the money paid for the same to the foresters. Sometimes it also seems to signify an immunity from this payment, by the king's grant. Crompton says expressly, it signifies to be free from the payment of money for taking of wood in a forest. See GELD.

**Wood-Hay**, an ancient custom at Exeter; by which a log out of every leam of wood brought over Ex-bridge is taken towards the reparation of that bridge. Antiq. of Exeter.

**Wood-Land**, in *Agriculture*, a term used by the farmers of many counties in England for a sort of soil, from its constant humidity and dark colour, reembling the soil in woods, which, of whatever nature it originally is, will always be made to appear thus from the continual dropping of trees, and the want of a free air and sun, together with the fall of leaves, destroyed and washed to pieces by the wet.

This soil in the open countries has a considerable quantity of clay in it, and holds the water a long time that once falls upon it: in wet weather it ilicks firmly to the plough-share, and in dry is very apt to crack. In uncultivated places it usually produces rufhe and rush-grafs. A moist and dripping year is extremely detrimental to this sort of land.

As to the clearing of wood-land in order to bring it into a state of cultivation and improvement, the first ftep is that of properly digging out the roots of whatever sorts they may be, after the wood has been cut off, to prepare the ground for the operation of the plough, without mixing the under stratum of the land with the fertile surface mouldy layer of earth. The hollows and pits are then to be filled and levelled.

In some instances it may be beneficial to encourage and promote the sward and herbage by fowing over the surface suitable gras-feeds, after it has been broken and spread over with the collected and decayed or burnt woody and leafy matters, stolking the land hard with fleep, and mowing off occasionally the wood-flights that may arise; thus keeping the whole in a state of cloce pulturate, until the smaller root parts that may have been left in the land become sufficiently decayed, to render them obedient to the plough, when the land may be broken up for corn. The use of lime and calcareous subfances in mixture with these matters, or spread alone over the land, would also serve to encourage the finer sorts of herbage, the delight of sheep; and, of course, induce them to eat the gras more close;
and bring the land sooner into the state of a thick set
ward, the productive matrix of corn-crops.

Wood-Lark, in Ornithology. See Wood-Lark.

Wood-Layer, in Agriculture, a term used to signify the
young oak or other timber plants which are laid down into
hedges, among the white thorn or other plants used in fences.
See Hedge.

Wood of Life, in Botany. See Guaiacum.

Wood-Loaf, in Ship-Building, a piece of elm, closely
fitted and sheathed with copper, in the throating or foree of the
pintle, near the load-water-line; so that when the ruder
is hung, and the wood-lock nailed in its place, it cannot
rise, because the latter butts against the underfiled of the
brace and butt of the foree.

Wood-Lounge. See Millevelles.

Wood-Meld, a coarse, hairy kind of stuff, made of Ice
cland wood, with which the ship carpenters, in some of his
masterys yards, line the ports of ships of war.

Wood-Mite, in Natural History, the name of a little ani-
mal frequently made the subject of microscopical obser-
vations, and by some called the wood-loaf; though that lets
properly, as there is another larger animal generally known
by that name.

The wood-mite is in shape and colour very like a lowne,
and is frequently found running very nimblly, but always by
starts and jumps, on old books and rotten wood. The eyes
of this creature are of a fine gold colour, and can be thrust
out or drawn in at pleasure; and when examined by the
microscope the peristaltic motion of the guts is seen very
diffinitely, and beautifully; and what is more wonderful,
there is observed a very distinct and regular motion in the
brain.

This probably is the same animal with the pediculus pul-
fatorius, described by Dr. Derham, as one of the death

Wood-Men, certain forest-officers appointed to take care
of the kings woods.

Wood-Mote, the ancient name of that forest-court, now
called the court of attachment.

Wood-Pecker, in Ornithology, the English name of some
species of picus.

The green wood-pecker, picus viridis of Linnaeus, called
also the rain-fowl and pluvialis avis, weighs about six ounces
and a half, is thirteen inches long, and twenty and a half
broad; the bill is dusky, triangular, and near two inches
long; the crown of the head is crimson, spotted with
black; the eyes are surrounded with black, beneath which
the males have a crimson mark; the back, neck, and lesser
covers of the wings, are green; the rump of a pale yellow;
the greater quill-feathers are dusky, spotted on each side
with white; the tail consists of ten stifl feathers with black
tips, and barred alternately with dusky and deep green;
the whole hinder part of the body is of a very pale green;
the thigh and vent are marked with dusky lines; the legs
and feet all of a cinereous green.

The greater-spotted wood-pecker, picus major of Linnaeus,
called also whitewall, weighs two ounces three-fourths, is nine
inches long, and sixteen broad; the bill is one inch and a
quarter long, of a black horn colour; the irides are red;
the forehead is of a pale buff colour; the crown of the
head of a glossy black; the hind part marked with a rich
deep crimson spot; the cheeks white, bounded beneath by
a black bar palling from the corner of the mouth, and sur-
rounding the hind part of the head; the neck is encircled
with a black colour; the throat and breast are of a yellowish-
white; the vent-feathers of a light crimson; the back, rump,
and covert of the tail, and lesser covert of the wings, are
black; the scapular feathers and covert, adjoining to them,
are white; the quill-feathers black, elegantly marked on
each web with round white spots; the four middle feathers
of the tail are black; the next tip with yellow; the bot-
tom of the two outermost black, the upper parts a dirty
white; the exterior feather marked on each side with two
black spots; the next with two on the inner web, and one
on the other; the legs are of a lead colour. The female
wants the crimson spot on the head. This species is much
more uncommon than the preceding; and keeps altogether
in the woods.

The middle wood-pecker, or picus medius of Linnaeus,
agrees with the preceding in size and colours, except that
the crown of the head in this is of a rich crimson; the
crown of the head in the male of the former being black,
and the crimson in form of a bar on the hind part.

The lesser-spotted wood-pecker, picus minor of Linnaeus,
is also called hickewall, and has all the characters and actions
of the greater kind, but is more rare. Pennant.

Wood-Pigeon. See Ring-Dove.

Wood-Plea Court, is a court held twice a year in the
forest of Clun, in Shropshire, for determining all matters
relating to wood, and the feeding of cattle there. Perhaps
it was originally the same with wood-mote court.

Wood-Pucron, in Natural History, a name given by M.
Reaumur to a small species of insect of the pucron kind,
of a greyish colour, and disting-uhlshed by its two hollow
horns on the hinder part of its body.

These animals very much resemble, both in shape and
size, the pucrons of the older; but as those live always on
the surface of the falk, these make their way deep into the
wood of a tree.

M. Reaumur found large quantities of these lodged at
a considerable depth in the wood of some elms, after they
were cut down; the passageways, by which they had made their
way in, were not to be found; but they were lodged in
large and long holes, of the diameter of a goose-quill, and
running many inches along the tree in a longitudinal
direction.

All the pucrons found in those places appear to be
females, and none have wings; they all have vast numbers
of young ones of different degrees of maturity within them,
and these may be forced out with pressing their bodies.

Wood-Roof, or Wood-ruff, in Botany. See Asperula.

The leaves and roots dried have been esteemed aperient
and diuretic; and recommended in obstrictions of the liver,
and thence suppos'd efficacious in the jaundice: but they
are now disused.

Wood-Sage. See Sage.

Wood-Soot, in Agriculture, a sublimate of the foot kind,
which has been found highly beneficial as a manure in cafes
of cold clayey or stiff loamy soils or lands, when in either
the state of pasture or in that of tillage for grain, or other
arable crops.

It is stated to be used in these proportions on different
fors of land. On light loams, when for pasture, from
twenty-two to twenty-four bushels on the acre; when for
barley, from thirty-three to thirty-four; for turnips, from
thirty-three to thirty-fix.

On chalky loams, when for pasture, from twenty-three to
twenty-six bushels on the acre; when for turnips, from
thirty-three to thirty-eight; for barley, from thirty-five to
forty.

On strong loams, when for pasture, from twenty-two to
twenty-
twenty-six bushels on the acre; when for artificial grasses, or green crops, from twenty-eight to thirty-four. See Soil and Wood-Soot.

Wood-Sorrel, in Botany. See Wood-Sorrel.

Wood-Spice, in Ornithology, an English name given by many to the common green wood-pecker.

Wood-Walp, in Agriculture, a name sometimes applied to dyer's-broom by farmers.

Wood, Waxed, in Gardening. See Genista.

Wood, in Geography, a county of Virginia, with 3036 inhabitants.

Wood Creek. See Preston's Creek.

Wood Creek, a river of New York, which runs into the Hudson, near Fort Edward. Also, a river of New York, connected with the Mohawk by the canal at Rome, through which the navigation is extended into Oneida lake. Also, a river of New York, which rises in Kingsbury, and runs N. by Port Anne village, into lake Champlain, at Whitehall landing, formerly Skeneborough.

Wood Island, a small island near the coast of Maine; 15 miles N.E. of Cape Porpoise. N. lat. 43° 26'. W. long. 76° 24'.

Wood River, a river of North America, which runs into the Missisipi, N. lat. 44°. W. long. 92° 25'.—Also, a river of North America, which runs into the Missisipi, N. lat. 38° 25'. W. long. 90° 58'.

Woodberry, a township of Pennsylvania, in the county of Huntingdon, with 1107 inhabitants.

Woodbridge, a large and populous market-town in the hundred of Loes, and county of Suffolk, England, is situated on the banks of the river Deben, at the distance of 8 miles E.N.E. from Ipswich, and 77 miles N.E. by E. from London. It is said to have taken its name from a wooden bridge built over a hollow way to make a communication between two parks, separated by the road which leads towards Ipswich; and near the spot where this bridge is supposed to have stood, a house, which to this day retains the name of the Dry Bridge. But when it is considered that in ancient times this town was written Odbruge, or, as in Domeaday-book, Udebruge, it may with greater probability be supposed thence to have derived its present appellation. The principal streets in Woodbridge, one of which is nearly a mile in length, contain many good houses, and are well paved. The market-place is well-built, and the centre of it is an ancient chire-hall, where the quarter sessions for the liberty of St. Etheldreda are held; under which is the place for the corn-market. A weekly market, granted in the reign of Henry III., is held on Saturdays, and here are two annual fairs. The only manufactures are those of sack-cloth and felt; but the commerce is of great importance. The Deben, which towards its mouth is called Woodbridge-haven, is navigable up to the town, which thereby carries on a very considerable traffic in corn, flour, malt, and various other articles, with London, Hull, Newcastle, and the continent: here are several docks for building vessels, with commodious wharfs and quays. In the population return of the year 1811, Woodbridge is stated to contain 702 houses, occupied by 4332 persons. The church, a spacious structure, is supposed to have been built in the reign of Edward III. by John, lord Seagrave. It consists of a nave, chancel, and two side aisles, the roofs of which are supported by fourteen beautiful flender pillars. The exterior walls are of black flints, as is also a large quadrangular tower, 108 feet in height; near the top, the flint and stone are curiously intermixed in various devices. On the south side of the church formerly stood a priory for black canons of the Augustine order. At the dissolution the site was granted by Henry VIII. to John Wingfield. After passing through several families, the estate was divided and sold, when the capital manor, called the abbey or priory, was purchased by Francis Brooke, esq. of Ufford. The town contains meeting-houses for Independents, Quakers, and Methodists; also a free grammar-school for ten boys, sons of the poorer inhabitants of the town, who are to be instructed in Latin and Greek, and fitted for the university. Here is likewise an almshouse, worthy of particular notice, which was founded and endowed in 1587, under a patent of queen Elizabeth, by Thomas Seckford, esq. for thirteen men and three women. The endowment was an estate in Clerkenwell, London, then let for 112l. 13s. 4d.; but leased in 1767 for fifty years at 563l. per annum, clear of all charges. And as vast sums have been recently expended upon the estate, it may reasonably be supposed that a considerable advance will take place at the expiration of the lease. The governors are the master of the rolls and the chief justice of the common pleas, who are empowered to make such regulations as from time to time shall be necessary. By the last ordinances, the annual allowance to the residents in the almshouse was increased to 27l. for the principal or nominal governor, and 20l. to each of the other twelve poor men, besides wearing apparel, and a child and half of coal. The three women are appointed as nurses and attendants on the men, and receive 12l. per annum, and clothing. The men wear a silver badge, with the Seckford arms, and are required to attend divine service at the parish-church on Sundays, Wednesdays, and Fridays, and all holidays.—Kirby's Suffolk Traveller, 8vo. 1764. Beauties of England and Wales, vol. xiv. Suffolk, by F. Shoberl. Woodbridge, a town of New Jersey; 4 miles N. of Amboy.

Woodbridge, a township of Connecticut, in the county of New Haven, with 2030 inhabitants; 7 miles N.W. of New Haven.

Woburn, a town of the county of Litchfield, with 1963 inhabitants; 30 miles S.W. of Hartford. Also, a town of the county of New Jersey, on the E. side of the Delaware, 5 miles S. of Philadelphia. N. lat. 39° 51'. W. long. 75° 15'. Also, a town of Vermont, in the county of Caledonia, with 225 inhabitants; 20 miles N. of New Haven. Also, a township of Pennsylvania, in the county of Bedford, with 1658 inhabitants.

Woodchester, a parochial village in the hundred of Longtree, and county of Gloucester, England, is situated 2 1/2 miles S.W. from Stroud, 1 1/4 S. from Gloucester, and 104 W. by N. from London. In 1811 the number of houses in the parish was 162, and the inhabitants 845. By its name Woodchester indicates its having been originally a Roman station, and many Roman antiquities have been frequently discovered there, of which the most remarkable is a mosaic pavement, partially laid open by digging graves in the church-yard under which it lies. It appeared to have formed a square of 48 feet 10 inches; and for size and richness of ornament is certainly superior to any similar tessellated pavement hitherto discovered in Britain. The tesseræ were imbedded in a cement about 8 inches thick, and under all were slabs crossing each other at right angles. Besides this curious work, others have been occasionally discovered at Woodchester; particularly in 1795 and 1796, the ground-plan of a very extensive Roman building was laid open, of which the remains in the church-yard formed the N. extremity, and the other parts extended under an adjoining orchard and field. The plan of this building comprised two courts,
court, which, with the great room, containing the principal pavement, ran through the middle, having numerous apartments of different dimensions branching out from them.

In three large rooms on the N. side of the great or first court were found fragments of columns, statues, and marbles. The second or inner court had galleries on three sides. The great mosaic pavement seemed to have belonged to the cavaedium, an interior court or hall, which communicated with several suites of rooms. Various parts of the building appear to have belonged to the apartments allotted for baths, exercise, &c.

That these remains were portions of a splendid Roman villa is scarcely to be doubted; and from their character the villa may have been the residence of the proprietor, while Britain was subject to Rome. Fragments of statues, pottery, itags'horns, glafs, and coins, have been found among the ruins. Of the coins, the oldest was one of Hadrian, and the latest of Valens. A dagger of iron, much corroded, two spurs of the same metal, a small brafs hatchet, a fibula, a key apparently of hardened clay, &c. were also discovered. The manor of Woodchester belongs to lord Ducie, who has a feat at Spring-park, in the parish, now deferred. It is romantically situated amidst fine woods.

A full account of the Roman villa, with plates, has been published by S. Lysons, in imperial folio.

WOO.

WooDcUTTER'S CREEK, in Geography, a river of East Florida, which runs into the Atlantic, N. lat. 29° 57'. W. long. 81° 40'.

WOODEN, a town of Poland, in the palatinate of Lublin; 52 miles N. of Lublin.

Wooden Ball, a small American island, near the coast of Maine. N. lat. 43° 50'. W. long. 68° 40'.

Wooden Frames, for preserving and retarding the Blooms of Fruit-trees, in Gardening, such as are contrived for the purpose of protecting the blossoms of them from the destructive effects of spring-frosts, &c. In this intention nets of different kinds, and screens of canvas rolled up in the day-time and let down at night, or in the time of heavy rains, have been mostly employed while the trees are in flower; but these frames are found to be superior, especially in exposed northern situations. By means of thus retarding and defending the blossoming of these sorts of tender trees, until the frosts be chiefly over, much advantage is said to be gained in the setting of the fruit.

These frames are constructed in a simple cheap manner; the revolving parts of which are covered with the branches of the silver fir, or those of some other fuch tree, which are found to answer the purpose very effectually; and when they are properly formed, they will open and shut with the greatest ease and expedition. They are in use from about the middle of February until towards the end of April, or later in some cafes; being only opened as there may be a necessity in the state of the blossoms.

They have been employed with great success for peaches and apricots, and may be used for many other sorts of tender fruit-trees.

In forming them, the upright poils are made of wood, two inches square, and fourteen feet six inches long, into which cross-bars are mortised; the poles standing six feet asunder. The upper leaves, which open outward on their pivots, are made of inch-deal, by an inch and a quarter in breadth. There are small pieces of wood nailed on the inside of the upper and middle bars, to prevent the leaves of the frames from falling inward on the wall. The lower leaves of the frames, which open out above, in order to admit the rays of the sun to the lower parts of the wall, revolve on pivots. The bottom or low end of the frames stand out two feet from the wall, and every other pole in them is fixed at the top, with an iron holdfast immediately under the coping of it. The leaves of the frames are covered with branches of the silver fir, so as to wholly occupy the vacant spaces at the end, middle, and sides of them. The cross-bars are made of inch and quarter wood, and of a breadth to correspond with the upright poles into which they are mortised. There are small wooden pins in the ends of the cross-bars, to hold the frames tight when they are up. The space between the wall and the frames should have a sort of partition at every twelve feet, formed by the silver fir branches, tied to the trees and every second pole, which will prevent a too free circulation of air along the wall, and preserve a degree of serenity very essential to the setting of the fruit.

These frames may be found very beneficial in many open and exposed aspects of garden-grounds. See a paper on the subject in the first volume of the "Memoirs of the Caledonian Horticultural Society."

Wooden Hoop for Chefs, in Rural Economy. See Darning.

Wooden Horse, in Military Language. See Horse, Wooden.

Wooden Horse-Collar. See Collar.

Wooden Saddle. See Pack-Saddle.

Wooden's Island, in Geography, a rocky islet in the North Pacific ocean, on the S. coast of King George III.'s Archipelago; so called by captain Vancouver, from Isaac Wooden, one of his crew, who fell overboard near it, and was drowned, a little to the east of Cape Ommannoy.

Wood-Engraving, or Xylography, is the art of making such incisions and hollows, imitative of natural or ideal objects, at the will of the designer, on a block or tablet of wood, as may afterward yield impressions on paper, its surface being supplied with printers'-ink in the manner of letter-types.

The wood of the apple or pear-tree, either of them occasionally, but more frequently the pear-tree, was used by those engravers of the European continent, who flourished during the 14th, 15th, and 16th centuries, and is believed to have been used for the same purpose, from a much earlier period, in China. The reason of this preference is the superior compactness of the texture of those woods, but the wood of the box-tree has latterly—for the same reason, namely, because it is yet more compact than the pear-tree in its grain, and harder in its substanee—superceded it; at least for the smaller purposes of such book-blocks as are intended to be combined in the letter-press, and printed at the same operation with alphabetic types.

The instruments used in this art are few and simple; and are probably the same now, with a few improvements of no great importance, that have been in use from the very commencement of the art; namely, gravers, more or less square or lozenge in their proportions, according to the breadth and depth of the lines required to be cut; scrapers, of various sizes, both flat and round, but chiefly the latter; knife-tools and pit-stickers, for the finer lines, pecks, or stipplings; and gouges, for the broader and deeper hollows, which are intended to be left untouched by the ink and paper in the process of printing.

The designs which formed the subjects of the more ancient engravers in wood, considered either of pure outlines, or very little more than outlines; the engraved blocks or tablets
WOOD-ENGRAVING.

Durer early applied himself to the study and further advancement of an art which at once promised to reward his labours with fame and fortune; and so well had nature qualified him for the task, that before the termination of the 15th century, he produced his series of wood-cuts of the Apocalypse; a work which it cannot be doubted was received throughout Europe with wonder and universal applause. Mr. Bartch strongly insists that neither Durer, Schauflein, Burgmair, nor the other great designers of the German school, who were contemporaneous, or nearly so, ever engraved in wood themselves; but that all they did was to furnish the designs, leaving the task of cutting them upon the tablets to the ordinary engravers in wood. Mr. Otley is, however, persuaded that this opinion is in a great measure erroneous, notwithstanding the inscriptions which Bartch refers to, written anciently upon the backs of so many of the engraved tablets of the celebrated triumph of Maximilian, and other works designed by Hans Burgmair, and recording the names of the individual wood-engravers who were employed to execute particular pieces of those extensive undertakings.

One hundred and thirty-five of the folio tablets of Maximilian's triumph are still preferred in the imperial library at Vienna, where an edition of them was struck off in the year 1796. According to Bartch, they were engraved from the design (for the whole forms but one long procession) not of Albert Durer, as had formerly been supposed, but of Hans Burgmair, in 1516 and the following years. The names of the different wood-engravers employed are written, says Mr. Bartch, upon the backs of several of the blocks, in the following manner. Upon No. 18 of the edition just mentioned, "Der kent an die Ellend. hat Wilhelm geschritten;" i.e., this block joins to that which represents the elk. It was engraved by William: and fo of the rest.


The imperial library likewise possesses an hundred and twenty-two blocks, engraved from the designs of Burgmair, representing the faints, male and female, of the family of Maximilian. One hundred and nineteen of these were re-published in the year 1799; and upon the backs of the blocks were found the names of the eight following engravers on wood; viz. 1. Hans Frank. 2. Corneille Liefink. 3. Alexi Lindt. 4. Joffe de Negker. 5. Wolfgang Rech. 6. Hans Taberith. 7. Wilhelm Taberith. And, 8. Nicholas Seeman. Probably no writer who has entered upon a critical examination of these early works has been so well qualified to judge of them as Mr. Otley: and that gentleman, while he admits that these inscriptions of names sufficiently prove that the great bulk of the numerous wood-cuts bearing the initials of Burgmair, were not cut upon the wooden blocks by his own hand; and that by parity of reasoning it might be fair to conclude the fame of a large proportion of those bearing the monograms or initials of Durer, and other eminent designers; yet he can by no means persuade himself that the abilities of the ordinary wood-engravers, who abounded in Germany at the time, were not adequate to the production of the plates which thus bear the marks of their hand. The engravers at Nuremberg were so numerous in their estimations, as Mr. Otley observes, that it is probable that any design engraved by one of them might appear as an autograph in the hands of another.
cloze of the 15th century, could have been such as to render them in any material degree instrumental in bringing about that sudden and considerable improvement which took place in their art at that period. They had been accustomed to manufacture the barbarous wood-cuts used by the illuminists and vendors of playing-cards, and were probably incapable of comprehending or appreciating those delicate, but free and masterly touches, which characterize the design of a great and finished artist like Durer; and if so, wholly unqualified to represent them with any tolerable degree of fidelity. We may, therefore, readily believe that the numerous and flourishing school of wood-engravers, which we find spreading over Germany, and from thence to Italy, in the early part of the 16th century, owes its excellence to the great designers of that time; and especially to Albert Durer, who during his youth affidavitly applied himself to the practice and improvement of the art, and afterward taught it to numerous pupils, who, already grounded in the principles of design, and working continually under the eye of their master, by degrees became qualified to assist him greatly in his numerous works of this kind. The intelligence, the delicacy, and the feeling, which we observe in the execution of most of the wood-cuts of Albert Durer, can only, Mr. Ottley thinks, be accounted for in this way; and the reader will probably admit that his opinion on the subject is not a little strengthened by the circumstance of Durer having been himself the publisher of all his chief works of this kind, more especially when added to the fact, that of the years 1509, 1510, and 1511, during which so large a proportion of his wood-engravings were executed, we have scarcely any thing by his hand engraved in copper.

The sudden and considerable improvement of which we have spoken, consisted of a superior style of execution, as well as of design. The meagre and miserable forms derived from the legends of superstition, and the Greek painters of the dark ages, began to give way to a clearer view of nature; and the few and scanty single-lined hatchings, which rather indicated than expressed shadow, were superseded by those bold courses of lines, as if hatched with a pen, and crossed with a second and in some instances with third courses of lines, which Wolgemuth introduced, and Durer improved.

This mode of execution appeared to many persons so very difficult, and requiring so much more of pains and patient labour than they were warranted by other parts of these engravings in believing to have been bestowed on them, as to have excited considerable doubts whether the prints which contain these dark croffings were really impressed from wooden blocks. They were by some persons rather supposed to have been printed from cafts, for which the engraved blocks served perhaps as matrices; and a controversy hinging on this doubt has been for some time carried on by antiquarian inquirers, with sufficient boldness on both sides. The truth, however, could only remain with one party, and the subsequent production by Mr. Ottley, of some of the engraved blocks of wood themselves, either from the hands of Albert Durer, or those of his disciples, has proved that the dark croffings were actually delivered from wood, and settled the controversy, as far as respects that artist and his contemporaries, if not his successors.

The readers of our account of the German school of engraving, may have observed that ourselves were among the number of sceptics. As the truth was our object, we willingly confess our earlier mistake now that the fact is ascertained; and have too much respect for truth and the public to feel the least backwardness in recording it. Whether we flatter ourselves that we can afford this record out of the flock of our reputation, is for our private feelings. If from our expression of doubt, research in the right direction, and satisfactory ascertaining, have refuted, our scepticism has not been in vain; nor have we been in vain anxious to tell what we believed, as well as what we knew. Respecting the dark crof-hatchings which so frequently occur in the works of Albert Durer, Mr. Ottley's argument is conclusive; yet there are two things in his book on engraving, for which we cannot allow to him the fame approbation; and these are, his discontinuing his history precisely at the same epoch where Mr. Landseer had been obliged to break off a course of (published) sketches that are confedently imperfect; and his misfiling both the words and meaning of that writer, in the only place where he professes to have quoted him.

We shall next proceed to describe the modes of workmanship, or execution, which have prevailed among the more modern practitioners of the art; beginning with that which is in use for the more common or ordinary purposes, and following with those refinements of the art which are practiced only by its superior professors. Our account will be followed by some anecdotes and remarks relative to the earlier history of the art, which we hope will prove in no small degree worthy of the notice of the connaisseur and print-collector.

Before the artist begins his engraving, the surface of the block or tablet which is to receive it, must, by means of an instrument termed a fcraper, succeeding to a fine waste-fpine faw, be made level, and sufficiently smooth for the reception of the design which is intended to be reprefented. Should this design be very simple in its nature, such as a small geometrical diagram, for example, being previously drawn on paper either with a black-lead pencil, or Indian ink, it is sometimes laid on an engraver's fand-bag, or other fuch hard cushion, and the block being carefully placed over it, a fmall blow struck on the back of the block with a broad-faced hammer, will transfer the lines from the paper to the wood, in a manner sufficiently plain and accurate for fuch purposes, when by means of the gravers, gouges, fcrapers, &c. which have been before mentioned, the engraver begins his work of incifions and hollows, scooping away the whole surface of the block, except the diagram, or other simple design required.

In other cases, the design to be engraved is either traced by passing a blunted ftool-point over the outlines, the back of the drawing being rubbed with powdered red-chalk, or is fketched out with a black-lead pencil, and the different shades washed in with Indian ink, in the fame manner as a chiaro-furo drawing on paper. This method is used in making drawings for cuts to be introduced in common and cheap publications, in which a bold fhey effect is chiefly required. In engraving fuch drawings made on the wood, the artist renders the feveral forms and tints by incifions cut in the block; and the principle on which he proceeds may be readily conceived by recollecting (what we have alluded to in an earlier part of this article), that were the block to be printed before the engraver commenced his operations, it would yield merely a black spot: every incision therefore made in the block will produce the impression of a white line or hatching, and thus afford the means of introducing any portion of light that may be required. By the multiplication of these white lines or hatchings, the engraver lightens the tint at his pleasure; and by the various widths, thicknesses, croffings, and interspaces of the incisions thus made in the wood, not only the forms and various gradations of shadow from light to darknes, but also the textures or external
WOOD-ENGRAVING.

external characters of the various objects which may enter into the composition, may be very well represented.

Another mode of proceeding is occasionally resorted to in cases where engravings of a superior and more elaborate character are required, and which we have reason to believe was first practiced in England by our countryman, Mr. John Thurston. In these cases, all the light and curious part of the design are hatched in, line by line, by the draftsman or designer himself, on the block, and which is performed either with a pen and Indian ink, after the manner of the first ancient artists of the German school of whom we have treated, or else with the more modern and elegant instrument, a black-lead pencil. In some instances we have known the whole composition in all its details, both of light and obscurity, thus finished upon the wood in the most elaborate manner, before the engraver began his work of incision and scooping; but in most instances, the shadows and parts requiring less definition, and where the engraver may with more safety be left to the guidance of his own judgment, are merely washed in with a camel’s-hair pencil and Indian ink, as in the foregoing method. Or else the designer uses a black-lead pencil, with which he rubs or scumbles in the less important tints. And the drawing on the wood being thus prepared, the engraver proceeds with the manual and linear portion of it, by cutting away the interstices between the pencilled or penned lines, as in the ancient manner, and the washed portion is treated in the modern method which we have described above.

Considerable skill on the part of the engraver is sometimes requisite in finishing the work, in order to unite and harmonize the whole, in which the designer’s aid is not unfrequently required, who on a proof impression taken for the purpose hatches and works, with a fine camel’s-hair pencil and white paint, over the diffusant parts, regulating at the same time the general effect, the drawing of the parts, and the style of execution. This touched-proof, viewed in the re-vering glass, is carefully copied by the engraver on his block, which concludes the process.

There is, however, in the nature of things, no reason whatever why these two characters of engraver and designer may not exist united in the same individual; nor are the instances of such union unfrequent in fact. Mr. Bewick, of Newcastle, whose highly-enriched volumes of engravings of birds and quadrupeds, adorned with delightful vignettes, are masterpieces of the art, and have merited and found a place in almost every library, polieles, with his xylographic powers, a fund of exquisite humour, an originality of thought, and an accuracy of observation of the details of nature; together with an adequate talent of expressing those observations, which are really as surprising as they are diverting and instructive.

We believe that this artist, or his deceased brother, was the first who adopted an expedient which the present writer has been informed was originally suggested by Mr. Bulmer, proprietor of the Shakspere printing-office; that of lowering a little the surface of his engraving, by means of a very broad flat scraper, in those parts where tenderness and delicacy of impression were more peculiarly desirable a thing trivial in itself, yet of sufficient importance in works that have pretensions to be regarded as highly finished, to have been subsequently imitated by most of the other engravers in wood. Among those who in modern times have united in themselves the characters of designers and wood-engravers, should also be mentioned Mr. Cennell, who has executed some of his own energetic compositions in a vigorous and masterly style, which few have been able to equal.

Mr. Thurston, more veried in all the technical varieties of linear practicability, and more accomplished in his academic powers of delineating the human form through all its gradations of action, character, and expression, than any of his predecessors in the xylographic art, in his habits of thought and style of design, is poetical, didactie, profound, allegoric, recondite. Of the professors of imitative art, who have wisely employed their talent to a moral purpose, few have improved and delighted us so much, or caused us to reflect so variously or so deeply. But though Mr. Thurston has engraved very successfully on copper, we believe that he has always entrusted his designs on wood to be executed by others, (some of them latterly by a son of promising talents,) and from the black-lead drawings of this artist, performed on the blocks themselves, have been produced the best engravings of the London and Liverpool schools. We subjoin the names and monograms of the principal of those artists who have been engaged in their execution—T. Cennell, T. R. Branston, R. J. Thompson, H. F. P. Hole, W. Hughes.

By the two latter of these we have seen landscape subjects of recent execution, which have excited in us no small degree of admiration of their professional powers. In a park-scene after Cuiti, engraved by Mr. Hughes, (who professes to have studied under Mr. Hole,) the trees more especially, which have been generally and justly regarded as objects more difficult to express in this mode of art, than almost any other species of objects whatever, are treated with a degree of looseness, freedom, and local knowledge of the characters of their various foliage, and modes of branching and ramification, that we believe is quite unprecedented, and much more resembling an etching on copper from the needle of Waterloo or Middleton, than any former production of the wood-engravers’ art. And there has also very lately appeared a book, entitled “The Club,” after the designs of Thurston, which is not less excellent in its way. It consists of twenty-four characteristic head-pieces of the several members of the club, a title-page representing the club collectively, besides various tail-piece vignettes, and impregnates us with a depth of philosophical penetration into the human character in all its varieties both natural and assumed; for here the nicest physiognomical traits which mark the fefer dichromations between wit, humour, and ridicule, in their various modifications, are faithfully rendered; indeed with a degree of delicacy and fidelity which until now we had not conceived to lie within this province of art.

In wood-engravings, like the belles of these modern productions which we have mentioned, there is more original feeling, more of the truth of nature, and the blunders of art, than in all the dry, monkish, legendary rubbish put together, toward which the dealers in and writers on such rarities (who are frequently the same persons) are so very anxious to attract and retain the public attention, and which are so ardently fought after by the wooden and would-be connaisseurs of the day.

Some few connaisseurs there are, nevertheless, that with great sensibility to the beauties of meritorious works of this kind, collect also the early rarities of the art as curiosities, and as interesting steps in tracing the march of European xylography, from its rude outlet towards its present attainments; but the idle occupation which so many expensive books have ridiculously promoted, the affected ebullitions of regard for what is merely scarce, and which, if it were plentiful, would be justly esteemed as mere rubbish, can scarcely be too severely reprehended, when we observe that...
by giving an erroneous direction to the public taste, it
operates as the very bane of modern merit, and of all prin-
cipled encouragement of the art.

A man who collects these early rarities, and these only,
may be pretty certainly pronounced to be a peril of no
intrinsic relics for the productions of art, and by no re-
ome analogies may be safely perceived to be in the predic-
cament of Rochefoucault's man of gravity, who assumes a
mysterious carriage of the body to cover the defects of
the mind.

Between the territories of Error and Truth, there is no
neutral ground; neither can be made to recede without the
other's advancing. Among the causes that, concurrently
with the above, have retarded the proverbs of the art of
wood-engravings, indifferent and bad printing ought first
and chiefly to be mentioned; for this evil is feverishly felt
by all modern designers and engravers on wood, and, like
most other evils, by far the most heavily by the left,) the delicate
parts of whose most elaborate performances are so fre-
quently marred by this operation.

The bad printing of wood-cuts generally proceeds from
one or more of the following mistakes, to use the mildest
term that occurs to us: Printers being unable of them-
telves to judge of the effect required in an impression;
their being generally too much alacrity in price by the
publishing-bookers to afford the necessary attention, even
were they better informed; the falsé respect exacted by
opulence, which renders them too ignorantly proud to sub-
mit to the direction of artists, who are generally poorer men
than themselves; with which caufe, prejudice in favour of
old methods of practice is always ready to unite itself;
the practice of over-damping English, French, and even
India paper. To which may be added the use of blanketking,
and the neglecting to have the engravings properly made
ready under the direction of the artist; all of which lead
to the general corollary, or inference, that the en-
graver should always superintend the printing of his own
works.

**WOOD-ENGRAVING. Origin and Ancient History of.**

Father Du Halde adduces very satisfactory reasons for
our believing that the art of engraving on wood ex-
isted and was practised in China for several centuries be-
fore its appearance in Europe. Whether it is of Chinese
transplantation, or spontaneous European growth; whether
it was introduced by the Venetian traders and travellers
to India, or was re-invented, as the baron Heinnaick sup-
popes, in Germany, by the Briefsmals and Formfehnihere,
who fabricated playing-cards, and the miserable legends
of monkish superlition; or whether it was not discovered,
as Papillon has alluded, at Ravenna, as early as the year
1285; have been examined with great critical attention,
and at least as much perseverance as the public will symp-
thize with, by the abbe Zani, Mr. Ottley, and others.

To the works respectively of the Italian abbe, and the Eng-
lish historian and connoisseur, we refer those who may be
deficient of obtaining more local and detailed information
concerning the early curiosities of the art than belongs to
the plan of our Cyclopedia. The story of the two Cunio,
which they have related at great length from Papillon, and
illustrated by their own more profound knowledge of the
subject, is romantic in the extreme: so much so, that the
antiquarian interest which the reader may feel with us on
the score of the curious wooden blocks from "the life of
the great and magnanimous Macedonian king," merges in
the chivalry and fine art, the poetic and pittoresque favour,
and the tragic fate, of the twin brother and sister, the ancient
pride of Ravenna, and of the illustrious house of Cunio.

Papillon relates, that when he was a young man, he "dis-
covered an epoch of engraving prints and characters on
wood, certainly much more ancient than any hitherto
known in Europe;" and the story of his discovery is, that
being employed about a century ago in papering a closet
for a Swiss captain of the name of De Greder, in the
village of Bagneux, near Mont-Rouge, the captain, find-
ing he possessed a taste for such matters, showed him two
or three very ancient volumes, and they converted to-
ergether concerning the prints contained in them, and the
Antiquity of engraving on wood. Papillon proceeds to
give the description of the principal, i. e. the most ancient,
of these volumes, as follows:—Upon a cartouch, or fron-
tifpiece, decorated with fanciful ornaments, and measuring
about nine inches in width by six in height, with, at the
top of it, the armorial bearings no doubt of the family of
Cunio, are rudely engraved the following words, in bad
Latin, or ancient Gothic Italian, with many abbreviations,
which were rendered and explained to him by M. de Greder.

"The heroic actions represented in figures, of the great
and magnanimous Macedonian king, the bold and valiant Alexander;
dedicated, presented, and humbly offered to the most holy father
pope Honorius IV., the glory and support of the Church, and
to our illustrious and generous father and mother, by us, Alfe-
andro Alberto Cunio, cavalier, and Isabella Cunio, twin
brother and sister: first reduced, imagined, and attempted to
be executed in relief, with a small knife, on blocks of wood, made
even and polished by this learned and dear sister, continued and
finished by us together, at Ravenna, from the eight pictures of our
invention, painted six times larger than here represented; en-
graved, explained by verses, and thus marked upon the paper to
persevere the number of them, and to enable us to present them
to our relations and friends, in testimony of gratitude, friendship,
and affection. All this we did, and finished by us when only sixteen
years of age."

The cartouch mentioned above is enclosed in a square
formed by a simple black line, one-twelfth of an inch in
thickness; a few light hatchings, irregularly placed, and
executed without precision, indicate the shadows of the or-
naments. "Immediately following this frontifpiece (says Pa-
pillon) are the eight pictures, engraved in wood, of the same
dimensions, and surrounded by a similiar fillet: they have
also a few faint hatchings, to indicate the shadows. At the
bottom of each of these prints, between the broad line or
fillet which bounds the subject, and another parallel line dif-
tant from it about the breadth of a finger, are four Latin
verses engraved upon the block, which poetically explain the
subject; and above each is its title. The inscriptions of all
of them are of a grey tint, and spotty; as if the paper had
not been dampened or wetted before it was laid upon the
engraved blocks. The figures, which are passable in respect
to their outlines, although of a semi-gothic taste, are suffi-
ciently well characterized and draped; one may perceive by
them that in Italy the arts of design were then beginning by
degrees to experience mellioration. The names of the prin-
cipal personages represented are engraved under their figures,
as Alexander, Philip, Darius, Camasphe, and others."

Papillon next describes the eight engravings severally,
which bear the names respectively of the twins Alexander
and Isabel Cunio, and it would appear from his descriptions
that Isabel was the superior artist of the two.

Upon the blank leaf which follows the last print, badly
written in old Swifs characters, and with ink too pale as to
be scarcely legible, is the following memorandum.

"This precious book was given to my grandfather,
Jan. Jacq. Turine, a native of Berne, by the illustrious
count di Cunio, magistrate (podesia) of Imola, who ho-

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nourished him with his liberal friendship. Of all the books
I possess, I esteem it the most, on account of the quarter
from whence it came into our family; and on account of
the science, the valour, the beauty of the amiable twins
Cunio, and their noble and generous intention of thus
gratifying their relatives and friends. Behold their singular
and curious history in the manner in which it was several
times related to me by my venerable father, and according
to which I have caused it to be written more legibly than
I myself could have done it.” What follows is written in a
clearer hand, and with blacker ink.

“`The young and amiable Cunio, twin brother and fitter,
were the first children of the son of the count di Cunio,
who had by a noble and beautiful Veronese lady, allied
to the family of pope Honorius IV., when he was only a
cardinal. This young nobleman had espoused this young
lady clandestinely, without the knowledge of the relations
of either of them; who, when they discovered the affair
by her pregnancy, caused the marriage to be annulled, and the
priest who had married the two lovers to be banished. The
noble lady, fearing equally the anger of her father and
that of the count di Cunio, took refuge in the house of one
of her aunts, where she was delivered of these twins.
Nevertheless the count di Cunio, out of regard to his son,
whom he obliged to espouse another noble lady, permitted
him to bring up these children in his house, which was
done with such prudence and tenderness as well as
on the part of the count as on that of his son’s wife, who
had conceived such an affection for Isabella Cunio, that she
loved and cherished her as if she had been her own daughter;
loving equally Alessandro Alberico Cunio her brother,
who, like his fitter, was full of talent, and of a most amiable
disposition. Both of them made rapid advances in various
sciences, profiting by the instructious of their masters; but
especially Isabella, who, at thirteen years of age, was
already considered a prodigy; for she perfectly
understood and wrote Latin, composed verses, had acquired
a knowledge of geometry, was skillful in music, and played
upon several instruments; moreover, she was practised in
drawing, and painted with taste and delicacy. Her brother,
urged on by emulation, endeavoured to equal her; often,
however, acknowledging that he felt he could never attain to so
high a degree of perfection. He himself was, nevertheless,
one of the finest young men of Italy; he equalled his fitter
in beauty of person, and possessed great courage, elevation
of soul, and an uncommon degree of facility in acquiring
and perfecting himself in whatever he applied to. Both
of them constituted the delight of their parents, and they loved
each other so perfectly, that the pleasure or chagrin of the
one or the other was divided between them. At fourteen
years of age, this young gentleman could manage a horse,
was practised in the use of arms, and in all exercises proper
for a young man of quality; he also understood Latin, and
had considerable skill in painting.

“His father having, in consequence of the troubles of Italy,
taken up arms, was induced, by his repeated solicitations,
to take him with him the same year, (viz. at the age of 14.)
that under the eyes of his father he might make his first
campaign. He was entrusted with the command of a
squadron of twenty-five horse; with which, for his first
effort, he attacked, routed, and put to flight, after a vigor-
ous resistance, almost two hundred of the enemy; but
his courage having carried him too far, he unexpectedly
found himself surrounded by many of the fugitives; from
whom, nevertheless, with a valour not to be equalled, he
succeeded in disengaging himself, without sustaining any
other injury than that of a wound in his left arm. His
father, who had flown to his succour, found him returning with
one of the standards of the enemy, with which he had
bound up his wound: he embraced him, full of delight
at his glorious achievement, and at the same time, as his son’s
wound was not considerable, and as he was desirous to re-
ward such great bravery upon the spot, he solemnly made
him a knight, (i.e. a knight-banneret;) although he was al-
ready one by his birth; dubbing him in the same place where
he had given such proofs of his extraordinary valour. The
young man was so transported with joy at this honour conferred
on him in the presence of the troops commanded by his
father, (who, in consequence of the death of his father, which
had recently happened, was now become the count di
Cunio,) that, wounded as he was, he instantly demanded
permission to go and see his mother, that he might inform
her of the glory and of the honour which he had just ac-
quired; which was granted by the count the more readily,
as he was glad to have this opportunity of testifying to that
noble and afflicted lady (who had always remained with
her aunt a few miles from Ravenna) the love and esteem
which he ever continued to entertain for her; of which he
certainly would have given more solid proofs, by re-estab-
lishing their marriage, and publicly espousing her, had he
not felt it his duty to cherish the wife his father had
oblige him to marry, by whom he had several children.

“The young knight, therefore, immediately set out,
accompanied by the remains of his troop, out of which he had
eight or ten men killed or wounded. With this equipage,
and the attendants, who bore testimony to his valour
wherever he passed, he arrived at the residence of his mother,
whom he had visited; after which he repaired to
Ravenna, to shew a similar mark of respect to the wife of
his father, who was so charmed by his noble actions, as well
as by his attentions towards her, that she herself led him
by the hand to the apartment of the amiable Isabella, who,
seeing him with his arm bound up, was at first alarmed.
He remained a few days in that city; but impatient to re-
turn to his father, that he might have an opportunity of
distinguishing himself by new exploits, he set off before his
wound was yet healed. The count reprimanded him for not
having sent back his troop, and for not remaining at Ravenna
till he was cured, and would not permit him to serve again
during the rest of the campaign: shortly after, when his
arm was perfectly healed, he sent him home, paying to him
pleasanfly, that he did not choose to be outdone by him all
the remaining time the troops would continue in action that
year. It was soon after this that Isabella and he began to
compose and execute the pictures of the actions of Alexander.
He made a second campaign with his father, after which he
again worked upon these pictures, conjointly with Isabella,
who applied herself to reduce them, and to engrave them
on blocks of wood. After they had finished and printed
these pieces, and presented them to pope Honorius, and to
their other relations and friends, the cavalier joined the army
for the fourth time, accompanied by a young nobleman,
one of his friends, called Pandulph; who, enamoured of
the lovely Isabella, was desirous to signalize himself, that
he might become more worthy of her hand before he espoused
her. But this last campaign was fatal to the ca-
valler Cunio: he fell, covered with wounds, by the side
of his friend, who, whilst attempting to defend him, was
also dangerously wounded. Isabella was so much affected
by the death of her brother, which happened when he was
not yet nineteen, that she determined never to marry: she
languished and died, when she had scarcely completed her
twentieth year. The death of this beautiful and learned
young lady was followed by that of her lover, who had
always hoped that his attentions and affections towards her
would be rewarded by her consent at length to become his,
and...
WOOD-ENGRAVING.

and also by that of her mother, who could not survive the loss of her beloved children. The count di Cunio, who had been deeply afflicted by the death of his son, could fearfully support that of his daughter. Even the countess di Cunio, who loved Isabella with great tenderness, fell ill of grief for her losses, and would have sunk under it, had she been supported by the manly fortitude of the count. Happily the health of the countess was, by degrees, re-established. Some years afterwards, the generous count di Cunio gave this copy of the actions of Alexander, bound, as it now is, to my grandfather; and I have curried the leaves of paper to be inserted, upon which, by my orders, this history was written."

From the name of pope Honorius IV. being engraved on the frontispiece of these ancient prints, it is certain that this precious monument of the art of engraving on wood was executed between the years 1284 and 1286; because that pope governed the church only for the space of two years, ending in April 1287. The epoch, therefore, of this ancient specimen of engraving, is anterior to all the books printed in Europe that have been hitherto known. Papillon adds, that it is very probable that the copy of the work, which is recorded to have been presented to pope Honorius, may very possibly be preferred in the library of the Vatican.

The baron Heinneckin and our countryman Strutt dis-trusted the truth of this story of the twins and their ancient work; but the latter has let escape that he read the original French with hasty inattention, and the former, after offering his objections, is compelled to add, "still there must be something true in Papillon's account; for, from my knowledge of his character, and his manner when I conversed with him, I am firmly persuaded that he did not invent that which he told me."

On the other hand, Zani confesses his entire belief of the account of Papillon, finding in it, as he states, "every mark of truth;" and Mr. Otley conclusively adds, that "Papillon from his infancy had begun to collect materials for illustrating the history of his favourite art, of which, as is well known, he became a professor of some eminence, having been instructed in it by his father, who was also an engraver on wood. This practical experience combined with research could not but give him great advantages, and render him the less liable to be deceived in his decisions."

"His remarks, indeed, are those of a man well accustomed to examine ancient prints. The blocks, he says, appear to have been printed by means of the press or friction of the hand, with a light tint of Indigo in dittemper; he describes the impressions to be granulous in some places, as if the paper had been applied to the engraved block without being first dampened. Now, it is well known that many of the very early wood-prints were printed without any mixture of oil in the colours used for the purpose; and there is good reason also to believe that the paper was often applied in its dry state. The observations of Papillon are, therefore, not only evidence that he examined these prints with great attention, but that his eye was habituated to very nice discrimination, touching all those particulars which, perhaps, more than any others that could be named, are guides to enable us to judge of the antiquity of wood-engravings. And the probity of Papillon's character seems to preclude the idea that he had any intention to deceive."

The general corollaries resulting from these elaborate inquiries, which have been pursued to much greater length than we have chosen to follow, are, that the origin of European wood-engraving is unknown, (that is to say, that no person is acquainted with the precise facts of who first en-graved on wood in this part of the world, or when it was done); and the reluctant acknowledgment that it cannot be shown to be an European discovery at all.

Notwithstanding the detailed proximity with which the chevalier Cunio's own account of his graphic enterprise is written, and though he states that himself and his father invented the eight designs or pictures from which their tablets were engraved, he says nothing of the far more important fact, had it been so, of their having invented an art of multiply ing those designs, so much more likely to have been announced by an ardent youth of sixteen, had there been the leaf foundation for such an announcement. No. He was too sincere: and he probably knew also that pope Honorius, and his noble relatives, were too well acquainted with familiar process employed by the Italian carvers, sealers, book-binders, and other artificers of Venice and Ravenna, (for the bindings of books were even then ornamented by means of heated iron stamps,) to have believed him, had he been less attentive to truth. He evidently regarded, and expected that his readers would regard, what he terms in one place engraving, and in another execution in relief with a small knife, as an expedient which might have been adopted by any other person in the existing state of that kind of knowledge, and which himself and father practised—in all probability from the imperfect report of some inexperienced reporter, who might be their instructor in drawing.

At the period of which we are treating, Venice, as is well known, was the splendid emporium of exotic luxuries and the reader will not hesitate to believe, that, with the facilities of Italian intercourse which then subsisted, much of the imported knowledge would travel at least to Ravenna, along with those foreign commodities and that commercial enterprise which were then spreading through Europe. The father and the uncle of Marco Polo, who had penetrated to Tartary and to China, returned from their nineteen years of travel in the East in the same year in which the Cunio were born. Nothing, therefore, is more likely, under all the attendant circumstances, than that these travellers brought home the information necessary to the rude practice of the wood-engravers' art from China, which we are inclined to deem the parent country of wood-engraving, paper, and printing; and that it thus became known, though through what particular medium cannot now be traced, to the illustrious and romantic twins of Ravenna.

Should it be objected here, that Marco Polo has not noticed this art, in the account which he has left us of the marvels which he had witnessed in China; the answer is obvious. Marco did not himself travel thither until after the first return of his father and uncle, nor did his book appear until ten years after that of "the heroic actions of the great and magnanimous Macedonian king," when wood-engraving would seem to have been no marvel. Marco very wisely preferred instructing the public in matters with which they were not hitherto acquainted.

In corroborato of this account may be mentioned, that the manner in which the work of the Cunio is described to have been performed, is precisely that in which the Chinese have from time immemorial engraved on wood, and in which they still continue to practice that art, as may be seen by any person who may please to indulge himself in the curiosity of inspecting those engraved or carved tablets of wood which are preferred in the museum of the Honourable East India Company, in Leadenhall-street.

We have pursued this mixture of fact and probability thus far, because it appeared to us to contain the best evidence on the subject that is now obtainable; and because even this seems to render the uselessly-protracted and never-ending disputes, which have been so long kept up by certain inter-
WOOD-ENGRAVING.

yelled print-dealers and their prey, and their literary jackalls, about the superior pretensions of Italy or Germany to the discovery of this art; a mere recreation of idle credulity; a wall ag of controversial ink and strength in flambeau effigies; an affair of spurious importance between "twaddle dum and tweedle dee."

If ridicule might find any other place in our Cyclopædia than under the letter R, we should here have recommended these rakish together of early German and Italian rubbishes; these disciples of their rival pretensions; these admirers of the miferable virgins, and meagre fants and favours of those dark ages of art, which preceded the resurrection of the antique sculpture; these complimenting and catalogue-making worshippers of the gods of tattefettines, who affect such an exquisite feeling for their wooden prodigies, to be confident, and use their utmost diligence in seeking after the chips of the twits of Ravenna, or the still earlier chips of the wood-engravers of China, and to tell the tattefettines and doting world of bibliographical cognoscenti, that these antique excursions are "graceful," or even more "elegant," than those which Cupid in shaving from his bow, in the celebrated picture by Correggio, in the collection of the most noble the marquis of Stafford.

In order to confer as much of fictitious importance as might be found practicable on these relics of early European engraving and printing, for which these writers affect so great veneration; and to keep up the delusive idea that xylography and block-printing were invented here rather than seen elsewhere, the difference between change of form and change of colour in rendering impressions has been dwelt on with some emphasis; but nothing in the processes of imprefling flamps is of more frequent and ordinary occurrence, than for sufficient light to accumulate in an intaglio flamp that has lain by for any length of time, to produce a change of colour in the first impression yielded after such lapse of time. It must even have been a common, because obvious and efficient, mode of cleaning out the engraver's work. How frequently must this have occurred in feeling, for example. How frequently it does occur now: and here, without genius or meditation, is the link supplied at once in the chain of petty caufes and effectes, that has been so much magnified by the simplicity and tattefettines of modern dealers and collectors.

Of the impression of eight copies, mentioned by Papillon, of the life of Alexander, from the hands of the Cunio, it is not known that any remain; nor will this excite purport, when we reflect that entire editions of some works that have been subfequently printed, have been swept from the face of day. The wood-engravings which succeeded thee by the interesting twins of Ravenna, or were produced about the fame period, appear to have been honestly thought of at the time; that is to say, thought of very little, because unworthy of being thought of much. From their non-importance, they have either all disappered, or, from the fame cause, not having been dated, the age of fuch of them as do remain, if any remain, is not known. The former of thefe is probably the chief reafon of their disapperance; for who would think of feeking for the tops of ballads, or the dying speeches of criminals, or dirty playing-cards, which were printed even fifty years ago, or of preferring such things if accidentally found? and the early European wood-engravings of which we are treating, until Michael Wolgemuth arose, and introduced his better works of this kind into the Nuremberg Chronicle, were scarcely of more consequence than the lowest objects of the notice of the vulgar.

But though the prints have disappered, a decree of the

fenate of Venice remains to attest their former existence, and that "the art and mystery of making cards and printed figures had," in the year 1441, "fallen to total decay; and this in confection of the great quantity of playing-cards and coloured figures printed, which are made out of Venice." The decree proceeds: "to which evil it is neceffary to apply some remedy, in order that the said artists, who are a great many in family, may find encouragement rather than foreigners; let it be ordered and established," &c. &c.

This edict, as Mr. Ottley has well observed, speaks of the art of making cards and printed figures in terms which would have been every way appropriate, had the edict had for its object the establishment of the oldest manufacture of Venice; and when coupled with other circumstances, especially the account of the two Cunio, furnishes a strong ground for the conjecture that engraving in wood had from a very early period been practised by the Venetians, who may easily be supposed to have learnt it in the course of their commerce with the Chinese.

The "printed figures," which are spoken of along with the playing-cards in the Venetian edict, were of the superstitious or devotional character to which we have already alluded, and which are described by Heinnekin as being soon afterward common in Germany and the Low Countries, when they were,—both the legendary wonders and the playing-cards,—designated by the name general term, and manufactured by the same hands; that is to say, cut in wood by the Formschneider, and coloured afterward by the Briefmaler. And to this testimony of the German writer, the professor Fuseli adds, that "in the vulgar tongue of Zurich, and still more in that of the Roman Catholic cantons of Switzerland, Helgen, which is a corruption of Heiligen, meaning holy fants, is used to denote any historical print." The reason he gives for which is, "the first prints represented the figures of saints, or other devotional subjests, and were on that account, termed Helgen; the term, in progress of time, became generic, as others do, and is now used to denote prints of any kind, even thoofe of profane subjests."

Of these superstitious excitements of the vulgar, the baron states, that he saw several which he believes to be of ancient date in the library of Wollenbuttel. "These pieces," says he, "are of the fame dimensions as our playing-cards; they measure three inches and a quarter in height, by two inches and a half in width." There are also in the same library, at the end of the book entitled "Ars Moriendi," five prints, in which are engraved divers figures of angels, devils, dying perons, saints, &c. similar to playing-cards, and of the same fize, each being marked with a letter of the alphabet.

An engraved outline of a figure of this kind, of St. Bridget writing, with the Virgin and Child above, surrounded by a fort of cloud of Gothic frill-work, and behind her a pilgrim's hat, wallet, and ruff, Mr. Otteley has brought forward from the collection of earl Spencer. Perplicitive is grossly violated here, and it is of more than twice the dimensions of an ordinary playing-card; but this print, with another mentioned by M. Thierry as being in the library of the public Academy at Lyons, and which is dated to be dated 1484, Mr. Otteley thinks may help to fill up the chasm between the work of the Cunio; and the larger print of St. Christopher crossing the water with the faced Infant, which is dated 1423, is also in the collection of the same noble earl, and will be found mentioned in a more particular manner in the commencement of our account of the German School of Engraving.
WOODFORD, in Geography, a county of Kentucky, bordering on the Ohio, with 3171 inhabitants, of whom 3179 are slaves. Veritas is the chief town, containing 488 inhabitants, of whom 235 are slaves.—Also, a town of Vermont, east of Bennington, in the county of Bennington, with 254 inhabitants.

WOODGURRY, a town of Hindooftan, in Bednore; 35 miles N.E. of Simogu.

WOODIOUR, a town of Hindooftan, in Coimbetore; 10 miles N. of Daraporum.

WOODRUFF, a town of Tunis; 7 miles N.W. of Gabs.

WOODRUFF, Sweet, in Agriculture, a perennial plant, which is eat by different forts of live-Rock; and the aromatic flowers of which, when infused in water, excel in flavour, it is said, the finest teas.

WOODS, Lake of the, in Geography, a lake of North America, so called from the multiplicity of wood growing on its banks, such as oaks, pines, firs, &c. Its greatest length is about 70 miles, and greatest breadth forty. It contains but few islands, and those small. N. lat. 49°. W. long. 90°.

Woods, a town of South Carolina; 32 miles W.N.W. of Georgetown.

Woods's Bay, a bay on the Istrafts of Magellan; 15 miles W. of Cape Froward. S. lat. 53° 58'. W. long. 72° 55'.

Woods's Island, a small island near the north coast of Jamaica. N. lat. 18° 12'. W. long. 76° 8'.

WOODSAMADRUM, a town of Hindooftan, in Golecoda; 12 miles S. of Dampetpa.

WOODSBOROUGH, a post-town of Maryland; 75 miles N. of Washington.

Woodsia, in Botany, owes its name to Mr. R. Brown, who dedicates this genus to the commemoration of Mr. Joseph Woods, F.L.S., an excellent British botanist. A valuable paper on the Rotes of this country, about to appear in the Transactions of the Linnean Society, will abundantly prove Mr. Woods’ claims to such a distinction, even were it far less indifferently belittled than usual.—Brown Tr. of Linn. Soc. v. 11. 170. Sm. Compend. Fl. Brit. ed. 2. 152. Pursh 660.—Clas and order, Cryptogama Filices. Nat. Ord. Filices dorifaux.

Gen. Ch. Fruitification in roundish groups, on the back of the leaf. Involucrum cup-like, open, small, nearly flat, jagged, fringed with awl-shaped, incurved, jointed hairs. Capules several, obovate, on short stalks, crowded, in the centre of the involucrum, each bound by a vertical, jointed, elatic ring, and burting irregularly at one side. Seeds numerous, kidney-shaped, granulated, extremely minute.

Eff. Ch. Groups of capules scattered, roundish, each seated on a capillary-fringed involucrum.

Obf. We gladly here adopt the term group, as technically synonomous with Sorus, (see that article,) instead of dot, spot, or line, which are liable to much exception.

1. W. longifolius. Long-leaved Woodsia. Br. n. 1. Pursh n. 2. (Acroplis longifolius; Linn. Sp. 1528. Fl. Dan. t. 391. Polypondium longifolium; Swartz Syn. Fil. 39. Wildi. Sp. Pl. v. 5. 198. "Schkuhr Crypt. 16. t. 19." Neophyron lanatum; Michaux Boreal-Amer. v. 2. 270. Lonchitis aspera linnifolius; Dalech. Hitt. 1221. f. 3.)—Frond pinnate; leaflets lanceolate, deeply pinnatifid, with numerous, nearly uniform, oblong lobes. This appears to have been first discovered in the Mediterranean isle of Iva, whence the specific name, which is very exceptional, the same species being found on rocks in the north of Europe, as well as in North America, from Canada to Virginia. We have American specimen from Mr. Francis Bourt, agreeing exactly with Siberian ones in the Linnean herbarium. We know not of this species having been detected in Britain. The fronds, five or six inches high, grow erect, in dense tufts. Their fronds, not quite half that height, are brown, bearing, like the mid-rib of each principal leaflet, many frap-shaped, taper-pointed, membranous scales. The frond itself is oblong, or lanceolate, composed of twelve or more pairs of oblong lanceolate leaflets, or pinnae, opposite or alternate, each about an inch long, numerous pinnatifid; their lower segments vary, nearly equal and uniform; upper confluent: their upper surface is even, nearly smooth, of a fine green; lower covered with pale brown scales, and crowned hairy groups of capules.

2. W. hyperborea. Round-leaved Woodsia. Brown n. 2. t. 11. Pursh n. 1. Sm. Compend. 158. (Acroplis hyperborea; Liljebad in Stockh. Trans. for 1793. 201. t. 8. A. alpinum; Bolt. Fil. Brit. 76. t. 42. Polypondium hyperborea; Swartz Syn. Fil. 39. Wildi. Sp. Pl. v. 5. 195. Sm. Engl. Bot. t. 2023. P. arvonica; Fl. Brit. 1115. P. Ilvens; With. 774. Filicaula pumilla, Lonchitis marantae species Cambobritannica; Pluk. Phyt. t. 89. f. 5.)—Frond pinnate; leaflets heart-shaped, rounded, pinnatifid, lobes rounded, waved, unequal.—Native of alpine rocks, chiefly in the northern parts of Europe. It occurs, though rarely, on the highest summits of the Welsh and Scottish mountains. A smaller plant than the preceding, often not above an inch high, though generally about three inches. The leaflets are shorter, and more rounded, as well as their lobes; of a thinner texture; much less deep pinnatifid, except at their base, where the bottom pair of lobes are often so deeply separated, as to form two little leaflets, wavy, or oblyrally lobed, and sometimes of unequal size. The main flalk is scaly; leaflets hairy on both sides.

We readily agree with Mr. Brown, that some intermediate varieties of each species render the specific characters of both considerably difficult. Yet there seems no reason to doubt their being distinct plants. Mr. Bauer's delineation of this fern, in the Linnean Transactions, excellently engraved by Warner, is one of the finest illustrations of a natural production that can any where be seen.

WOODSTOCK, (New,) in Geography, a borough and market-town in the hundred of Wootton, and county of Oxford, England, is situated 8 miles N.N.W. from Oxford, and 62½ W.N.W. from London. It has a market on Tuesday, and fairs on the 5th of April, Tuesday in Whit-feek, 2d of August, 2d of October, Tuesday after the 1st of November, and 17th of December. The town sends two representatives to parliament, the mayor being the returning officer. The corporation consists of a mayor, a high-lieutenant, a recorder, town-clerk, four aldermen, and sixteen common-council men. In 1811, the houses in Woodstock were 235, and the inhabitants 1540. The fourth part of the present church is a fragment of an ancient chapel; but the northern face and the tower were erected in 1785. Adjoining to the church is a grammar-school, founded in 1685 by Mr. Cornwell, a native of the place; and near the southern entrance of the town is a range of almshouses, erected in 1793 by the duchess of Marlborough, for six poor widows. The town-hall, a stone building, has under it the market-place, and was erected in 1766, from a design of Sir William Chambers, at the expense of the late duke of Marlborough. The principal manufactures of the town are those of gloves and of polished steel. Various articles of this steel have been executed with great delicacy, and sold at high prices. This manufacture was introduced into Woodstock at the beginning of the last century; but
it has much declined, on account of the cheapness of the cutlery goods furnished by Birmingham and Sheffield. The glove-manufacture is of later date; but has increased in the present day so much, that from 300 to 400 pairs of gloves are made weekly in the town and the neighbouring villages, and thus afford employment for about 1400 women and girls, and 70 men. Old Woodstock, of which only one mansion and a few irregular houses remain, stood on a sheltered situation on the little river Glynne, which supplies the magnificent piece of water in Blenheim-park. The manor-house, or royal palace, on the N. bank of the deep valley of the Glynne, within the bounds of the park, was the residence of Fair Rosamond, whose romantic adventures are deeply interwoven with the history of Henry II.; but the building has long disappeared. In this palace, that king, in 1164, received the homage of Malcolm, king of Scotland, and Rice, prince of Wales. In 1275 Edward I. held a parliament at Woodstock, and there was born his second son, Edmund, as was also the renowned Black Prince. Woodstock was inhabited occasionally by Richard II., and there Henry III. narrowly escaped afflication by a fanatic priest: an attempt was there also made by Morisco on the life of Henry VIII. The old palace was afterwards employed as a prison for Elizabeth, his daughter. In the time of the civil wars it suffered severely from the parliament's party; and about a century ago the gate-house, the last fragment of the edifice, was pulled down. But Woodstock is most worthy of note for having produced Chaucer, who was born there about 1328. The house in which he afterwards resided, while the court was in the palace, stood at the W. end of the town, near the usual entrance into Blenheim-park. Some relics of this building are still pointed out.

The great object of attraction at Woodstock is the magnificent palace of Blenheim, with the surrounding grounds, water, and park. The honour and estates of Woodstock, long belonging to the crown, were in 1705 conveyed by queen Anne, on the address of the house of commons, to the illustrious John, duke of Marlborough, to preserve the memory of his eminent services as a warrior and a statesman; particularly for the signal victory obtained by him, and prince Eugene of Savoy, at Blenheim, in Germany, over the French and Bavarians, on the 2d of August, 1704. The house was erected by Sir John Vanbrugh, as a convenient distance from the S. brink of a deep dell, in which ran the Glynne. The general distribution of this superb structure consists of a central mass of buildings, including two small courts, and connected by colonnaded wings to two spacious quadrangles, forming the grand court of entrance. The centre is ornamented with a Corinthian portico, surmounted by a pediment and military emblems. The wings are crowned with towers serving at once to contain the chimneys, and to contribute to the picturesque grandeur of the edifice. The garden-front, extending from E. to W. 348 feet, is grand and magnificent. The interior of the mansion contains many noble apartments, adorned with paintings of eminent masters; particularly with a series of mythological pictures from the admirable pencil of Titian, presented to the first duke of Marlborough by the king of Sardinia, and with portraits of many eminent characters by the best artists. The library, occupying the whole of the W. front, 183 feet long and nearly 32 wide, is a magnificent room, originally designed to be a picture-gallery, but afterwards furnished with the grand Sunderland collection of books, containing upwards of 17,000 volumes. At one end is a marble statue of queen Anne by Rybrack. In the W. wing is the chapel appropriately fitted up, and containing a monument, by the fame sculptor, of the first duke, his duchesses, and their two sons, who died young. In the E. quadrangle of offices is the theatre, originally a green-house, calculated to accommodate 200 spectators. Near the E. angle of the mansion an observatory was erected by the late duke of Marlborough, and provided with a complete apparatus for astronomical observations by Ramsden; a great telescope by Herchel was presented to the duke by his majesty, after his visit to Blenheim in 1786. The flat approach to the palace is by a straight avenue from the N. extremity of the park, over the river, by a bridge of one spacious and two smaller arches. Flowing in a deep dell, the small stream is made to assume the appearance of a naturally-winding river, expanding below the bridge into a broad irregular lake; thus, with the bridge, according to the grandeur of the palace and the noble extent of the park.

A lofty colonnade is erected in the midst of the great avenue, surmounted by a statue of the great duke, and charged on the pedetals with inscriptions stating his services and rewards. In the N.W. part of the park of Blenheim, vestiges may be traced of the ancient road, Akeman-street. Nearly two miles W. from the park is the village of Stonesfield, at which place was discovered, in 1711, a telfellated pavement 35 feet by 20, representing, among other figures, a Bacchus, with his thyrsus and cup, mounted on a tyger. In addition to this curious antique, in 1779 were discovered, near the same spot, the areas of a number of other apartments paved in the same manner; and adjoining were the remains of a bath with its hypocaust. Roman coins from Vestaian downwards were found on the same spot. A plan and some account of these remains have been published by Henry Hakewill, eqq. architect.—Beauties of England and Wales, Oxfordshire, by J. N. Brewer, 8vo. 1811. The Blenheim Guide, by Dr. Malon, 12mo. 1817.

Havell's Views of Seats include two fine Engravings of Blenheim Palace, and a critical Account of the House, Scenery, &c. folio, 1818.

WOODSTOCK, a town of the county of Windham, with 2654 inhabitants; 57 miles S.W. of Bolton.—Allo, a town of North Carolina, on the left bank of Pamlico river; 22 miles N.N.E. of Newbern.—Allo, a poll-town of Virginia; 112 miles W. of Washington.—Allo, a poll-town of Vermont, in the county of Windsor, with 2672 inhabitants; 5 miles N.W. of Windsor.—Allo, a township of New York; 46 miles S. of Albany.—Allo, a poll-town of New Jersey; 26 miles S.S.W. of Philadelphia.

WOODVILLE, William, M.D. in Biography, was born at Cockermouth, in the year 1752. Having received a good classical education in his native town, he was placed with a respectable apothecary, to whom he served a short apprenticeship. He afterwards proceeded to Edinburgh, where, after the usual residence, he obtained, in 1775, the degree of M.D., having written and defended a very ingenious thesis "De irritabilitate fibrarum motricium." After passing some time on the continent, he returned and settled near his native place, where he practised his profession five or six years. Dr. Woodville then came to London, and was soon appointed one of the physicians to the Middlesex Dispensary, the duties of which office he discharged in an exemplary manner. In 1790 he published the first part, which was afterwards completed in four quarto volumes, of a highly valuable work, intitled "Medical Botany." In 1791 he was elected physician to the Smallpox Hospital, in the room of the late Dr. Archer; and it may truly be said, that no man ever devoted, more conscientiously or zealously, time and great talents, to the promotion of an object, than did Dr. Woodville to improvement in the medical treatment of the patients, as well as in the
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the general government of the establishment. To the
officers of the hospital, and those governors who took most
interest in its welfare, his merits were well known; and
some of the fruits of his genius and industry are before
the public in a volume which was published in 1796, inti-
tled "The History of the Small-pox in Great Britain, &c.
" This work, which it was the author's design to occupy
two volumes in 8vo., was well conceived, including a brief
history of the disease, and a review of all the publications on
the subject of inoculation, with an experimental inquiry
into the relative advantages of the various measures that had
been recommended. Only the first volume of this work,
which is well written, and contains much valuable informa-
tion, was published; the happy discovery of the efficacy
of vaccination having, in the author's opinion, superceded
the necessity of the second appearing. Dr. Jenner's grand
discovery made a due impression on the mind of Woodville;
and as no other man had equal opportunities of witnessing
and lamenting the ravages of the small-pox, so no person
could be more sincerely anxious and active in the adoption of
time means that were found adequate to guard mankind against
that pestilence. It is very true, that on the subject of
vaccination he was, like every body else, at first sceptical;
but he suffered no opportunity to be lost of ascertaining its
efficacy, and then of proclaiming his belief in it. Un-
happily, in some of his early experiments an error was com-
mitted; he was not aware of the influence of the various
atmosphere of the hospital. The result was, that in certain
infantile, either pure small-pox matter, or a deteriorated
vaccine lymph, had been injected into the arms of some
patients. The effects were faithfully detailed; but being
so different from those that had been described by Dr. Jenner,
that excellent man and benefactor to the human race visited
Dr. Woodville, with whom he argued and remonstrated on the
subject. It is to be regretted that some asperities of
remark took place between them, although both were
equally and honourably engaged in the development of
truth. The discussion, however, as is always the case,
proved very useful in the differentiation of the new practice;
and if Dr. Jenner had reason to find fault with the result of
Dr. Woodville's early proceedings, he must have been
abundantly gratified by his subsequent experiments and
publications. The ample field in which Woodville was placed
enabled him to vaccinate great multitudes, some thousands
of whom he afterwards told by variolous inoculation, and thus
gave that publicity to vaccination, and that confidence in
it, which it could not otherwise have attained in the course
of many years. He was also ardently engaged in the inquiry
into the nature and origin of the vaccine lymph; and, at his re-
quell, the writer of this short article three times inoculated him
with fresh grave from the heel of a diseased horse. If in
the heat and bitterness of contention men seek an apology
for unguarded expressions and affections, this cannot be
granted to those who calumniate the dead; and therefore
the statement in a late history of vaccination of Dr. Wood-
ville having fallen a victim to the drinking of ardent
spirits, is deserving of reprobation. Dr. Woodville cul-
tivated the society of his professional brethren, by whom, on
account of his talents and companionable qualities, he was
held in high estimation; and one of those who enjoyed the
intimacy of his friendship, from the period of his settling in
London until the day of his death, contradicts the above
unfounded calumny. His disease, which terminated in
drooply, had made such gradual advances during the last year
of his life, that he frequently talked of his death, which no
man ever contemplated with greater equanimity, as likely to
take place about a certain assigned period.

He died at the hospital on the 26th of March 1805; and

on the 3d of April, a warm and just eulogium was pronounced
over the body in the falcon by his friend Mr. Highmore.
His parents having been Quakers, he by his own desire was
interred in the Friends' burial-ground in Bushhill-fields, after
a very appropriate address at the grave by Mrs. Pryor.
The editor is indebted for the preceding article to his
much-esteem'd friend J. Norris, Esq., no less distinguished
by his mental and moral qualities than by judgment and
extent of reputation in his profession.

WOODVILLE, in Geography, a post-town of Virginia;
93 miles W. of Washington.

WOODWARD, John, in Biography, was born in
Derbyshire in 1664, and being intended for trade,
apprenticed in London; but in a little while abandoned
the shop for the sake of scientific pursuits. In 1687 Dr. Bar-
wick took him into his family, and for the space of four
years gave him instruction in medicine and anatomy.
He then recommended him to the medical professorship
in Gresham college, to which he was elected in 1692. Having
directed his particular attention to fossils, with a view to
which he had travelled through many districts of England,
he published in 1695 "An Essay towards a Natural History
of the Earth and terrestrial Bodies, especially Minerals;
also of the Sea, Rivers, and Springs; with an Account of
the Universal Deluge, and of the Effects that it had upon
the Earth," 8vo. His preparatory knowledge for a work
of this kind was very slight, and therefore the execution of
it was attacked by Dr. Martin Lister, and others. How-
ever, in the imperfect state of geology at that time, his
performance engaged notice, and he was chosen in 1693 a
fellow of the Royal Society. At this time he was in pos-
session of an ancient iron sword, in the concavity of which
was a sculpture representing the Rory of Camillus and the
Gauls at Rome; and as it was a great curiosity among the
learned, Dodwell gave an account of it in a Latin treatise,
titled "De Parma equellri Woodwardiana Differatio.
By this circumstance Woodward was led to increase his
acquaintance with a certain class of literati, though he did
not escape the ridicule of the wits. In 1695 he was created
M.D. by archbishop Tenison, and in 1696 he obtained the
same degree from Cambridge; and thus honoured, he was
prepared for an admission into the College of Physicians as
a fellow in 1702. But pursuing his inquiries into natural
history and antiquities, he published some pieces in these
departments: viz. "Some Thoughts and Experiments
concerning Vegetation," communicated to the Royal So-
ciety, and printed in the Philosophical Transactions for
1669; "Naturalis Historia Telluris illustrata et aucta: a
cedit Methodia Fossilium in Clavis Distributo," 1714,
intended as a grand reply to those who objected to his
Natural History of the Earth, which had been translated
into Latin by Scheuchzer at Zurich; and "An Account
of some Roman Urns, and other Antiquities, lately digged
up near Bathopgate; with brief Reflections upon the an-
cient and present State of London: in a Letter to Sir
Christopher Wren." In his medical capacity, he published
in 1718 "The State of Physic and of Diseases, &c." 8vo,
in which he advanced the notion, that the bile and its salts,
re-aborbed into the blood, were the true cause of life and
animal motions, and that the same fermenting in the
bowels were the cause of diseases; whence he was led to
conclude that emetics to evacuate the morbid bile, and oily
and unguinous medicines to correct it, were universal
remedies. This publication produced a controversy with Dr.
Freind, in which Woodward was answer'd both ludicrously
and feriollly, so that he gained little credit by his medical
theory or practice. His chagrin, however, was diverted by
the study of fossils, and the augmentation of his cabinet of
specimens.
specimens. He soon after fell into a decline, which terminated his life in his apartments at Gresham college in 1727, at the age of 63. He bequeathed his peronal property to the university of Cambridge, for the endowment of an annual lectureship, on a subject taken from his own writings in natural history or phyfic. Soon after his death were published an English edition of his "Method of Fossils," with various additions; and a Catalogue of Fossils in the Collection of J. Woodward, M.D., in 2 tomes, 8vo., a work of permanent estimation among geologists. In 1737 Dr. Templeman published Woodward's "Select Cakes and Confections in Phyfic," in which some valuable observations are interperfed. One of his hypotheses was, that the life resides in the blood, and in the separate parts of the body, not in the nerves; in confirmation of which he made many experiments, eftablishing the vis inertia of muscles. Biog. Brit. Haller. Gen. Biog.

Woodward, an officer of the forest, whose function is to look after the woods, and observe any offences either in vert, or venfion, committed within his charge; and to prevent the fame; and in cafe any deer are found killed, or hurt, to inform the verderer thereof, and prevent the delinquents at the next court of the forest.

Woodwards may not walk with bows and shafts, but with forest-bills. Arcum et calamos gefarre in foefia non licet, sed (ut refcripti utar verbo) hactem tantummodo. Term. Hill. an. 13 Ed. III.

Woodwardia, in Botany, a very fine and well-marked genus of ferns, dedicated by the writer of this article to the honour of his long and highly-valued friend, and botanical companion, Thomas Jenkinson Woodward, esq., L.L.B., F.L.S., one of the best English botanists, whose skill and acumen are only equalled by his liberality and zeal in the service of science. Mr. Woodward's name is well known as the important assistant of Dr. Withering in his national Flora (see Witheringia), as well as by his learned communications to the Linnean Society; amongst which, an essay on the British Fuci, written in conjunction with the present learned bishop of Carlisle, and printed in the third volume of that Society's Transactions, stands conspicuous.


Eff. Ch. Groups of capsules oblong, distinct, straight, ranged in a simple row, in bordered cavities, parallel to each side of the rib. Involutum superficial, velvety, separating towards the rib.

Obf. Mr. Brown has separated from this genus, by the name of Doodia, Prod. Nov. Holl. v. 1. 151, such species as have a flat involucrum, unconnected at its inner margin, and originating from an interbranching, or connecting, vein, at its opposite side. In thefe the capsules are not sunk into any bordered cavity, nor are the groups, with their involuca, co turgid, or prominent. Woodwardia candida, Cav. Leccion. 264. Swartz Syn. Fil. n. 2. Wild. n. 2, belongs to this genus of Doodia; and Mr. Brown defines two others, afera and media, as likewise natives of New Holland, in which country, it feems, no true Woodwardia has been found.

1. W. angulifolius. Narrow-leaved Woodwardia. Sm. n. 2. Swartz n. 1. "W. floridana; Schkuhr Crypt. 103. t. 111." W. onucleoides; Willd. n. 1. Pursh n. 1. Onolea nodulosa; Michaux Boreal.-Am. v. 2. 272. Swartz Syn. Fil. 111. Acorfolium areolaunum; Linn. Sp. 1526. A. n. 12; Linn. Am. Acad. 274. Ondium carolinianum; Walt. Carol. 257. Lonchitis major virginiana, folio vario, aliis Polypondin modum conjunctis; Morif. F. 14. t. 2. f. 24. Filix floridana, prelongis et angulis pinnulis, &c.; Pluk. Amath. t. 399. f. 1. —Fronds pinnate; leaflets linear, acute, entire; the barren ones finely ferrate. In cedar and cypresses, from New Jersey to Florida, fructifying in Augul. Perennial, about a foot high. Puršo. The root is creeping, fealy and fraggie, bearing severaI flaked, upright, smooth fronds, of a lanceolate figure, with a long taper point; the barren ones confliding entirely of lanceolate, acute, finely ferrate leaflets, deciduous at their base, and somewhat confluent: the fertile of rather fewer, more diftant, longer and narrower ones, likewise slightly confluent and confluent at their base, each leaflet being nearly covered at the back, on each side of the leaf, with a clofe series of turgid, nearly cylindrical, groups, a quarter of an inch long, of numerous capsules, every group closely covered by its own convex involucrum. Each group is encompassed with a considerably elevated uninterrupted line, bordering the hollow in which it lies. Withenow has molt unadvisedly changed the estabfihed specific name, without any right or pretence, fiirely for the worse rather than the better.

2. W. japonica. Blunt-lobed Japan Woodwardia. Sm. n. 2. Swartz n. 3. Wild. n. 3. Sprengel as above, f. 29. (Blechnum japonicum; Thumn. Jap. 333. t. 35. Linn. Suppl. 445.) —Frond pinnate; leaflets fTeife, half pinnatifid, with close, obtuse, ferrated lobes. Rows of fructification extremely close and crowded.—Gathered by Thunberg near Nagafaki, and in other parts of Japan, fructifying in June. Frond two feet, or more, in height. Stalk roughfih, and somewhat fealy, not smooth. Leaflets five or six inches long, pointed, quite feifie, fealy at the base, each divided about half way to its rib into twelve pair, or more, of broad, blunt, rounded, ferrated lobes, above an inch long, and half an inch broad, close fioe and parallel at the fides; palter beneath. Groups oblong, three or four in a continued line, close to the rib on each fide. The involucrum reflexed to one fide, after the capsules are fallen, leaves the cavity exposed, and like a box with its lid. The capsules appear all to be infringed into that margin of the cavity to which the involucrum, or lid, is attached.

3. W. orientalis. Sharp-lobed Japan Woodwardia. Swartz n. 4. also p. 315. Wild. n. 4. ("Blechnum radicans; Houtt. N. Flaft. v. 2. 197. f. 131."—Frond pinnate; leaflets flaked, deeply pinnatifid, with spreading, acute, ferrated lobes. Rows of fructification clofe. Involucrum somewhat creafte-shaped.—Gathered by Thun-berg in Japan. Very different from the left, as well as from W. radicans. The frond is more coriaceous than either, and seems to be rather glaucous. Stalk smooth and naked, at least in its upper part. Leaflets the size of the leaf, but tapering at their base into a flort flak; their segments considerably diftant from each other, except at the very base, and somewhat revolute; sharply ferrated, particularly at the point. Groups fliortly lunate outwards, especially the upper and shorter ones, about seven in each row, crowded, and close to the rib. Perhaps it was from a fpecimen of this, confounded with the preceding, that Prof. Thunberg defcribed the main flak as altogether smooth, and zigzag.

Pluk. means fubllance. With and from 24.) liquid. larger Involucrum high " is Fruftification 2.)—fuppofed externally no is fomewhat 113. " none this we fure rather half memt, prickly with the upper half of the fround, forming lines all along their principal rib, at each fide, as well as along the rib of each segment; the groups finally confluent. The deprifions in which the groups are feated are very flight, though not imperceptible, and the involucrem of each is narrow, lefs vaulted, and sooner turned aside, than in any other fpecies with which we are acquainted, fo that the preffent plant is in some meaure intermediate between Woodwardia and Doodia. Per- haps it may prove these two genera not to be ditinct, but while they remain so, we concur with Mr. Brown in keeping this fpecies where it is. Plukenet's figure was drawn by Mr. Banifter, the original discoverer of this fern.

5. W. thelypodiw. Small Woodwardia. Purf. n. 3. —" Fround pinnate; leaflets fefile, linear-lanceolate, pinnatifid; villos at the base; segments of the barren ones oblong and blunt; of the fertile ones shortened, triangular, and acute; all entire. Stalk downy, angular."—In fandy fwamps of South Carolina, near Charlestown, fructifying in July. Refembles the preceding, but is not half the fize. Purf.

6. W. spmbrata. Fringed Woodwardia. —Fround pinnate; leaflets fefile, deeply pinnatifid, with fpreading, rather acute, lobes, fringed with sharp teeth.—Gathered by Mr. Mensies, on the west coast of North America. This is larger in every part than W. virginica, and differ- guifhed from that fpecies by its more acute segments, whose margin is very confpiciously and copiously fringed with prickly teeth, directed towards the point. Groups of capfules large and turgid, ranged, a little obliquely, along the ribs of the segments, from three to five pair on each segment, none at the mid-rib of the leaflet itself. Involucrem strongly and permanently vaulted. The bottom fome of each leaflet, at the lower fide, is shortened, dilated, and half heart-shaped, as is more rarely the case in W. virginica. Several of the upper leaflets are decurrent and confluent; the top ones undivided, and barren.


8. W. fans. Swartz n. 6. "Schkuhr Crypt. 104. t. 113." Wild. —Fround pinnate; leaflets nearly fefile, deeply pinnatifid, with parallel, taper-pointed, sharply fterated lobes. Native of deep clayey fifferes of rocks in Madeira, according to Koenig. Found also in Italy and Portugal. A hardy greenhouse plant in England, and one of the moft handfome of its tribe. The frounds are two or three feet high, and a foot and a half or near two feet in breadth, of a fine green, smooth, beautifully reticulated with veins, each main falk producing at the back, near the top, a round leafy bud, or bulb, the origin of a young plant. Leaflets generally alternate, often a fpan long, somewhat peltinate, with a long very slender point; their numerous segments more or lefs crowded, flightly curved, lanceolate, minutely and sharply fterated, each tapering to a sharp elongated point. Groups of capfules about four fpair on each segment, (none at the mid-rib of the leaflet,) close, direct, fcarcey ever at all darivaried, turgid, pale brown, the cervices in which they lie very neatly and confpiciously bordered: uppermoft leaflets fimple and confluent, as in the foregoing fpecies. We know not how the W. fans, which Cavanilles feems, by Swartz's work, to have first noticed, is fupposed to differ from the radicans; but Willdenow afferts, on a comparison of numerous fpecies, from different countries, that there is no specific diftinction between them.

8. W. dispar. Various-leaved Woodwardia. Wild. n. 7. (Filiat latifolia, pinnulis fere acuminitis, dentata; Plum. Fil. 13. t. 16.) —Fround pinnate; leaflets fefile, lanceolate, pointed, pinnatifid, with elliptic-lanceolate, entire lobes. Fructification crowded on the much smaller lobes, of a separate narrower fround.—Found by Plumier in Martinico. Willdenow appears to have adopted this fpecies entirely from Plumier, a hazardous meafure, as its genus can only be gneefed from analogy. The barren frounds ap- proach the lalt fpecies in fize, but their segments are shorter, entire, rather obtuse, and by no means taper-pointed. Thofe frounds which bear fruit have leaflets fimilar in fhape and fizes to the others, but about one-third as large, at moft, bearing a fimple crowded row of fructification close to the rib of each segment. The groups of capfules are some- what elliptical, and there is nothing adverfe to the generic character of a Woodwardia; but, on the other hand, there is no particular indication of that character.

The root is defcribed above an inch thick, and six inches in length; externally black, with several vermicular branch- ing fibres, clothed with tawny or golden pubefcence. Stalk of each fround near eighteen inches high, pale brown and smooth, leafy from its midle part to the summit, where it terminates in a large erect leaflet, conftucted ex- actly like the refl., being equal in fize to the larger lateral ones, and conliderably excceeding those immediately below it. Such is the habit of W. angulifolia, but not of the other fpecies in general.

WOODY Fibrous Matter, in Agriculture, that which is produced from small particles of different forts of woody lubfiances.

When merely formed of these parts, it is fupposed to be the only vegetable matter that requires the aid of fermentation to render it nutritive to plants. The used bark of the tanner is a lubfance of this fort, which is very ab- sorbent and retentive of moisfure, but not penetrable by the roots of plants. See Tanners' Bark.

Woody fibrous matter may likewise be prepared fo as to become a manure, by the action of lime upon it.

It is obferved in the "Elements of Agricultural Chemi- try," that as woody fibre conflits principally of the ele- ments of water and carbon, the latter being in larger quantities than in the other vegetable compounds, any pro- cess that tends to abract carbonaceous matter from it, must bring it nearer in composition to the soluble principles; and that this is done in fermentation, by the abforption of oxygen and production of carbonic acid; and that a similar effect is produced by lime. See Lime.

WOODY Nightshade. See Nightshade.

WOODY Head, in Geography, a high cape on the coast of New Zealand, in the South Pacific ocean. S. lat. 37° 42'.

Woo
The distinction between wool and hair is rather arbitrary than natural, consisting in the greater or lesser degrees of softness, softness, and pliability of the fibres. When they possess these properties as far as to admit of their being spun and woven into a texture sufficiently pliable to be used as an article of dress, they are called wool. The gradations between wool and hair on the skins of some animals are often too minute to admit of accurate distinction. The fleeces of many sheep contain fibres so hard and coarse, that they may most properly be called hair; and some hairy animals produce on part of their skins fibres poling all the properties of wool; even in fleeces from the sheep, we may sometimes observe the very same fibre to be a coarse hair at one end, and at the other end a comparatively soft wool. The power of words, when inaccurately applied in denoting the properties of growth, may frequently be traced in the most common occurrences of life, and we are persuaded it has had no inconsiderable effect in this instance, in preventing the cultivation of wool in Europe, on the skins of other animals besides sheep. No one will deny that it is impossible to produce wool on the backs of the ox or the aif, if we restrict the term wool to the fleece of the sheep; but if by wool we understand a soft fine hair, polishing all the properties which render it fitable to be spun, wowed, and fulfilled, to make cloth, the oxen of Thibet and the aifes of Chili do produce and have for centuries produced such wool. Many of the aifes and oxen even in this kingdom have soft woolly tufts on their heads; in some parts of their skins, in which they are selected, and the breed cultivated, it is probable we might obtain from them a valuable addition to the materials on which national industry might be profitably employed.

Sheep's-wool appears to be the product of cultivation; we know of no wild animal which resembles the wool-bearing sheep. The argali, from which all the varieties of sheep are supposed to be derived, is covered with short hair, at the bottom of which, close to the skin, there is a softer hair, or down. (See Argali and Sheep.) This is not peculiar to the argali; almost all quadrupeds inhabiting cold climates are covered in the same manner with a soft hair or down, which is protected by a coat of longer and coarser hair. By removal to a temperate climate, or when placed under the fostering care of man, and protected from the inclemencies of the weather, and supplied regularly with food, the coarse long hair falls off, and the animal retains only the softer and shorter hair, or wool. It is also observed that European sheep, removed to tropical climates and much exposed, soon become languid and sickly, and lose their fleece, which is succeeded by a covering of short coarse hair. Sheep in exposed situations in Europe often produce short coarse white hairs called kemp, intermixed with the finer wool; on removal to a warmer station, and to a richer pasture, the coarse hairs fall off, and do not grow again. These facts are sufficient to prove the effect of cultivation on the fleece; and it must be observed that sheep's-wool of a good quality is never found in those countries which have been the seats of the arts, and where a considerable degree of luxury or refinement exists, or has once prevailed. This is a strong presumptive proof that such wool has been originally obtained by a careful and long-continued attention to the selection of those sheep which produced the finest and most valued fleeces.

Angora, the ancient Ancyra, the former seat of arts and manufactures, still retains its breed of fine-woolled animals, among which the goat at the present time produces a fleece nearly equal to silk in lustre and fineness; and the cat and the rabbit of that district yet produce fine long wool. Damascus, and the other ancient cities of Asia Minor, preserve in

**WOODY ISLAND, an island in the East Indian sea.** N. lat. 1° 46'. E. long. 106° 5'. See Victoire.

**WOODY POINT, a cape on the west coast of North America.** N. lat. 50°. W. long. 128° 5'.

**WOODYCUTTY, a town of Hindooftan, in Canara; 8 miles E. of Onore.**

**WOOF, among Manufafturers, the threads which the weavers shoot across, with an instrument called the shuttle, between the threads of the warp, to form the web.**

The wool is of different matter, according to the piece to be wrought. In tailory, both wool and warp are silk. In mohairs, the wool is usually flux, and the warp silk. In fattsins, the warp is frequently wool, and the wood silk.**

**WOOFEE, a name given in some parts of England to the Sea-wool, or lupus marinus; which see.**

**WOOGINOOS, in Botany. See Brucea Antidy- Federation.**

**WO-OO-SHIEN, in Geography, a town of China, in the province of Kiang-nan, near the river Yang-tze-kiang, a narrow cut leading from the river to the city, and flowing through the suburbs. This is a place of considerable trade; in the suburb there are several good dwelling-houses, apparently belonging to persons of distinction; and in the city itself there are many shops, which, it is said, would not disgrace the Strand or Oxford-street in London. These shops are spacious, containing an inner and outward compartment, and well supplied with articles of all kinds, both of raw and manufactured produce. The porcelain shops are particularly large, and contain great varieties of the manufacture. The main street leading directly through the city is not less than a mile in length. Several streets branch off from this, which are all paved, and contain good houses. The number of shops that are fitted with lanterns of all descriptions, both horn and paper, indicate manufactories of those articles. The principal wall of the city extends on the north face; and the other is fo overtopped with houses, that it almost escapes notice in passing down the main street, which it crosses. On the declivity of a hill to the northward are the temple and ancient tower. The temple, to which there is an ascent by a very steep stone stair-case, resembles that at Nankin, the god Fo being represented by the same attributes, and the principal hall being surrounded by similar figures of faces, in the same style. In another temple in the suburb there was a greater resemblance to that of Nankin. Woo-hoo-shien does not seem to be populous in proportion to the number of shops, and the quantity of accumulated produce exported for sale. The suburb near the city contains several good shops, which were crowded with people. Ellis's Journal of the late Embafty to China, vol. ii. Lond. 1818.

**WOODEDA, a town of Algiers, in the province of Tremecen, anciently called Guagida; 20 miles W.S.W. of Tremecen.**

**WOOL, in Natural History and Manufaftures, Latin lana, lanitium, Fr. lain, signifies soft hair or down, more particularly that of sheep, but is applied to the soft hair of other animals, as of the vicunna, commonly called Vigonia wool, that of the yak of Tartary, &c.; and also to fine vegetable fibres, as cotton. The Romans applied the term extensively to the soft hair or down of all quadrupeds, and even to that of birds, as lana anferina, the wool or down of the goose; lana caprina, goat's-wool. They also applied the term to vegetable substances:—

"Nemora Ethiopia molli canentia lana."

Virg. Georg. ii. 120.

"The trees of Ethiopia, white with soft wool, or cotton."
in their vicinity the traces of the former cultivation of fine-woolled animals. The Tarentine fine-woolled sheep, so much valued by the Greeks and Romans, were obtained from Asia Minor, and were on that account sometimes called Afians. It is highly probable that these sheep came originally from the more eastern parts of luxury, where the soft fleeces are now grown, of which the fawns and cloths of India are fabricated.

In countries where manufactures have once flourished, their effects continue for a long time visible in the race of sheep which still remain there. Even in the present condition of the fleeces from Barbary and the adjoining states, the experienced eye may perceive the vestiges of a fine-woolled race of sheep, degenerated by utter neglect, in a climate naturally unfavourable to the production of fine wool. In Sicily and the southern parts of Italy, the remains of the ancient Tarentine breed preserve to the present day a race of fine-woolled sheep, but greatly degenerated by neglect.

In Portugal the fine-wool sheep retain more of their original purity, but are still much neglected. In Spain attention to the growth of fine wool appears never to have been entirely lost sight of, and it is here that the race of fine-woolled sheep exist in the highest degree of perfection, though, as we shall afterwards state, probably inferior in some important qualities to the original Tarentine race. Some writers have asserted that fine wool is the result of climate and food; but this is not the fact, though we admit that both have some influence on the quality of wool. It is the breed alone that primarily determines the fineness of the fleece; this has been ably demonstrated by the experiments of Lord Sommerville, Dr. Parry of Bath, and others in this country, and by experiments on a larger scale in Sweden, Denmark, Saxony, and France.

It has been ascertained by Mr. Bakewell of Dithley, in Leicestershire, that the form of animals might be changed by feeding such as had any remarkable peculiarities, and continuing to breed from them for a few generations, when a new race is established, in which these peculiarities continue permanent. It has been ascertained by careful observations, both of cattle-breeders and physiologists, that in producing a new breed from two varieties of the same species, the female has more influence over the form of the progeny than the male; but with respect to wool the cafe is reversed, the quality of the fleece depending more on the fire than the dam. Beginning to breed from a coarse-woolled ewe and a pure fine-woolled ram, the produce of the first crosses will have a fleece approaching one-half to the fineness of that of the ram; and continuing to cross this progeny with a fine-woolled ram, equal to the first in quality, the fleece of the second and crosses will approach three-fourths to the fineness of the first, and in a few crosses more will be brought to an equal quality. If we flate it numerically, and suppose the wool of the ewe to be twice as coarse as that of the ram, or as 320 to 160, the first crosses will have the fibre reduced to 240, the second to 200, the third to 180, the fourth to 170, the fifth to 150, the sixth to 140, which to all practical purposes may be regarded as equal to the first number. This ratio of approximation may be stated as correct on a large scale of experiment. If we breed with a fine-woolled ewe and a coarse-woolled ram, the series would be reversed, and in a few generations all vestiges of the fine-woolled race would be nearly, if not entirely, extinct. The ancient Romans, in the time of Columella, seem to have been fully aware of the effects of breed on the fineness of the wool, and as much as 200 florins was paid for a fine-woolled ram.

When a flock of fine-woolled sheep are once formed, they can only be kept pure by feeding and preferring the finest-woolled rams, and most carefully avoiding all intermixtures with sheep from coarser-woolled flocks that may exist in the country. Where this is neglected, the quality of the wool will soon be debased.

But supposing all the flocks in a country were of the fine-woolled race, accidental varieties of coarse-woolled sheep will occur among them, or of sheep having fleeces intermixed with coarse hairs. If these be not carefully examined and removed, the wool will deteriorate, and more so where the climate is variable, and the sheep exposed to great and sudden vicissitudes of temperature.

What has been stated may suffice to explain the circumstance of fine-woolled breeds of sheep being only found in the vicinity of present or ancient manufactures, or where they have been transported from such districts. Wherever fine-wool sheep are neglected by man, the wool becomes either coarse, or intermixed with coarse hairs; the latter is the case in the Shetland isles, and in all countries where the arts and manufactures have been entirely destroyed, and ignorant barbarians have succeeded as the poseyors of the soil.

Most ancient writers on wool, and even many moderns, seem not to be aware of any difference in wools, except the finenes or coarsenes of the fibre; but the length of the fibre constitutes a far more important distinctive character. Long wool, or what is called combing-wool, differs more from short or clothing wool, in the use to which it is applied, and the mode of manufacture, than from wool from cotton.

Sheep's wool may, therefore, be divided into two kinds. Short wool, or clothing-wool, and long or combing wool; each of these kinds may be subdivided into a variety of sorts, according to their degrees of fineness. This process is the proper labour of the wool-roller.

Short wool, or clothing-wool, may vary in length from one to three or four inches; if it be longer it requires to be cut or broken, to prepare it for the further processes of the cloth manufacture. Short or clothing wool is always carded or broken upon an instrument with fine short teeth, by which the fibres are opened and spread in every direction, and the fabrics made from it are subjected to the processes of felting, which we shall afterwards describe. By this process, the fibres become matted together, and the texture rendered more compact.

Long or combing wool may vary in length from three to eight or ten inches: it is prepared on a comb or instrument, with rows of long feel teeth, which open the fibres, and arrange them longitudinally: in the thread from spun combed wool, the fibres or filaments of the wool are arranged in the same manner, or similar to those of flax, and the pieces when woven are not subjected to the processes of felting.

The shorter combing-wools are principally used for hofe, and are spun finer than the longer combing-wools, the former being made into what is called hard worsted yarn, and the latter into soft worsted yarn.

Short Clothing-Wool. — The principal qualities deserving attention in clothing-wools are the regular finenes of the hair or pile, its softness and tendency to felt, the length and foundness of the staple, and the colour. The wool-buyer also regards as important the clean state of the fleece, and to the grower its weight is particularly deserving attention; for in fleeces equally fine, from sheep of the same fize, some may be much heavier than others, the fibres of wool being grown closer to each other on the skin.

The finenes of the hair or fibre can only be estimated to any useful purpose, in the woollen manufacture, by the wool-roller or wool-dealer, accustomed by long habit to
differ
differ a minute difference, which is quite imperceptible to common observers, and scarcely appreciable by the most powerful microscopes. Of the various attempts that have been made to reduce the fineness of wool to a certain standard, by admixture with a micrometer, we shall afterwards speak. From some experiments we have made, as well as from those by Mr. Lucecock, Dr. Parry, and others, we may estimate the thinness of the hair of the finest Spanish and Saxony wool to be not more than the fifteen-hundredth part of an inch, and that of the finest native English to be from twelve to thirteen-hundredth parts, whilst the inferior sorts gradually increase to the fix-hundredth part of an inch and more. A difference in the size of these fibres, too minute to be noticed by the common observer, may occasion a difference of 40 per cent, or more in the value of the wool. The thinness of the hair has been ever considered as an important quality since the clothing manufacture emerged from its rudest state. Fine wool was formerly valued because a finer thread could be spun from it, and a thinner fabric made, than from the coarser wools; but since recent mechanical improvements have been introduced into the woollen manufacture, it has been found practicable to spin coarse wools to the same length as the finer wools were formerly spun to. It is well known, however, to cloth-manufacturers, that whatever be the thinness of the yarn, unless the wool be fine, it is impossible to make a fine, compact, and even cloth, in which the thread shall be covered with a thick soft pile; nor would a thin cloth made from coarse wool have the same durability or appearance as one from fine wool of equal weight per yard. Fine wool will, therefore, always prefer a superior value to the coarse; indeed it was long considered as the principal and almost the only quality deserving the attention of the wool-grower, the wool-falter, and the clothier.

The regular fineness of the fibre is also an object of considerable importance; the lower end of the staple, or that part of the fleece nearest the skin, will sometimes be very fine, and the upper part coarse. In some fine fleeces there will frequently be an intermixture of long, silvery, coarse hairs, and in other fine fleeces an intermixture of short, thick, opaque hairs, called kempes. When the wool is thus irregularly fine or intermixed, it is technically called not being true grown. The fine fleeces of Spain and Portugal, particularly of the latter country, are many of them injured by the intermixture of the long silvery hairs before-mentioned: whether this be owing to the original Tarentine breed having been crossed with the coarse-wooled native sheep of Spain, (see the article Sheep,) and still preferring a tendency to revert to their first condition, or whether it be the effect of heat on the skin, is uncertain. The Saxony fleeces, from the same breed, removed to colder climates, are generally free from this defect. The coarse short hairs, or kempes, are not uncommon in some of the fine-wooled fleeces of England and Wales, particularly those which are more exposed to the inclemencies of the weather, and have a scanty or irregular supply of food. It has been observed, in the first part of the article Sheep, that in some fleeces the proportion of fine wool in each fleece is much greater than in others, for in few or none is the wool grown uniformly fine over the whole body.

On the Merino sheep the fleece is more regular, whatever be the degree of fineness, than on any of our native English fine-wooled breeds. The Merino fleece admits of a division into four sorts, the refine, the fana, and the tercera, with a very minute portion of coarse from the shanks and head, which is not sent to market. The three sorts are distinguished in commerce by the marks R, F, and T. On the average, there will be in each fleece nearly three-fourths of the best or R wool. The second and third sorts, or the F and T, will also contain a considerable portion as fine as the best; but being shorter and discoloured, or intermixed with coarse hairs, which require their locks to be separated from the best sort, or the refine.

In the native English fleeces, however some part may be, the proportion of the best sort rarely exceeds one-third part, and is frequently not more than one-fifth part of the whole fleece.

The value of the best sort of a Spanish fleece, or the R wool, varies greatly in different flocks. When this sort, from the most esteemed fleeces, may be worth six shillings and sixpence per pound in the English market, the R wool from another flock may not be worth more than three shillings and sixpence. The F and T wools are from 25 to 50 per cent. lower than the first sort; thus, the inferior sorts from the finest piles may be of greater value than the best sort or R wool of other piles; but they are never intermixed by the dealers, as they are applicable to different fabrics. In the English mode of wool-forting, there will frequently be eight or ten sorts in a single fleece; and if the best wool of one fleece be not equal to the finest sort, it is thrown to a second, third, or fourth, or a still lower sort, which is of an equal degree of fineness with it. The best English short native fleeces, such as the fine Norfolk and South Down, are generally divided by the wool-forters into the following sorts, varying in degree of fineness from each other, which are called,

Prime,
Choice,
Super,
Head,
Downrights,
Seconds,
Fine abb,
Coarse abb,
Livery,
Short coarse or breech wool.

Besides these sorts of white clothing wool, two and generally three sorts of grey wool are made, consisting of locks which may be black, or intermixed with grey hairs. Some wool-forters also throw out any remarkably fine locks in the prime, and make a small quantity of a superior sort, which they call picklock. The origin of some of the above names is obscure, but the names of the finer sorts appear to indicate either a progressive improvement in the quality of the wool, or in the art of wool-forting. The relative value of each sort varies considerably, according to the greater demand for coarse, fine, or middle cloths; and the variation during and since the late war in the Spanish peninsula has been much increased by temporary causes. Before that period, when the R wool of good Spanish piles sold at from five shillings and sixpence to five shillings per pound, the prime from Herefordshire fleeces was sold at about three shillings and sixpence, and that from the Norfolk and South Down from three shillings to three shillings and twopence per pound. The higher price of the Herefordshire was in part owing to its being in a cleaner state. The Spanish wool is also cleaner than any of the English wools, being scoured after it is shorn; but the latter is only imperfectly washed on the sheep, previously to its being shorn. A pack of English clothing wool of 240 pounds weight, in its marketable state, will raise about 70 pounds in the proceeds of the manufacture; the same quantity of Spanish wool, as sent to market, will not raise more than 48 pounds on
WOOL.

on the average. This contributes to enhance the difference between the prices of each, as well as the superior fineness of the latter.

Different wool-sorters make a considerable variation in their modes of sorting the same kind of fleeces; some divide them into more sorts than others; but the following table will shew what may be taken as the average relative value of each sort, when the prime is worth about three shillings and two-pence per pound, and may serve to shew the skill required to estimate the value of fine English wool in the fleece.

<table>
<thead>
<tr>
<th>Sort</th>
<th>s. d.</th>
<th>s. d.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prime</td>
<td>3 0</td>
<td>3 4</td>
</tr>
<tr>
<td>Choice</td>
<td>2 4</td>
<td>2 8</td>
</tr>
<tr>
<td>Super</td>
<td>2 0</td>
<td>2 2</td>
</tr>
<tr>
<td>Head</td>
<td>1 8</td>
<td>1 10</td>
</tr>
<tr>
<td>Downrights</td>
<td>1 5</td>
<td>1 6</td>
</tr>
<tr>
<td>Seconds</td>
<td>1 3</td>
<td>1 4</td>
</tr>
<tr>
<td>Fine abb</td>
<td>1 0</td>
<td>1 1</td>
</tr>
<tr>
<td>Coarse ditto</td>
<td>0 9</td>
<td>0 10</td>
</tr>
<tr>
<td>Livery</td>
<td>0 8</td>
<td>0 10</td>
</tr>
<tr>
<td>Short coarse</td>
<td>0 7</td>
<td>0 8</td>
</tr>
</tbody>
</table>

The demand for coarse woollen goods having greatly increased of late, the prices of the lower sorts are considerably advanced from the above-stated prices, and are at present as under:

<table>
<thead>
<tr>
<th>Sort</th>
<th>s. d.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short coarse</td>
<td>1 4</td>
</tr>
<tr>
<td>Livery</td>
<td>1 5</td>
</tr>
<tr>
<td>Fine abb</td>
<td>1 6</td>
</tr>
<tr>
<td>Seconds</td>
<td>1 7</td>
</tr>
<tr>
<td>Downrights</td>
<td>1 8</td>
</tr>
<tr>
<td>Head</td>
<td>1 10</td>
</tr>
<tr>
<td>Super</td>
<td>2 0</td>
</tr>
<tr>
<td>Choice</td>
<td>2 2</td>
</tr>
<tr>
<td>Prime</td>
<td>2 6</td>
</tr>
<tr>
<td>Picklock</td>
<td>3 0</td>
</tr>
</tbody>
</table>

The Softness of fine clothing wool is next in importance to the fineness of the fibre, though it has been little attened to in the culture of English wool. This quality is not dependent on the fineness of the fibre; it consists in the peculiar feel which approaches to that of silk or down, but in which the wool of all European sheep is inferior to that of Eastern Asia, or to the wool of the vicuña, or llama of Peru and Chili. In foreign European wools there are different degrees of this property, where the fibre is equally fine. In our native English wools, the like difference exists between the softness of wool possessing the same degree of fineness, but grown in different districts. In the harder wool, the fibre is elastic and hard to the touch, and cloth made from it has the same hard feel; it is also more loose in its texture, and the surface of the thread is generally more bare. The difference in the value of cloth from two kinds of wool, equally fine, but one distinguished for its softness, and the other for the contrary quality, is such, that with the same procefs and expense of manufacture, the one will make a cloth more valuable than the other from twenty to twenty-five per cent.

Though the English woolen manufactures had been carried on for so long a period, the cause of this difference in cloths made from wool equally fine was but very imperfectly known till the present century. Mr. Robert Bakewell, then of Wakefield in Yorkshire, first directed the attention of wool-growers and manufacturers to this subject, in a work, entitled "Observations on the Influence of Soil and Climate on Wool." The reason why the manufacturers remained so long ignorant respecting it arose, he observed, from the manner in which the woolen-trade had been carried on in Yorkshire, the great seat of the manufacture of English clothing-wool, the division of employment there not permitting the wool-dealer, or even the clothier, to witness the final result of the process. The wool-bayer in the diffident counties, and the wool-forter, who divided the fleece, were equally unequipped with the cloth manufacture. The Yorkshire clothier sold his goods in an undressed, and often in an undyed state; they were bought and finisbed by the cloth merchant, who was formerly unequipped with the previous procefs of the manufacture, or the qualities of wool. In a promiscuous lot of undressed cloth bought at the same price, and apparently of the same quality in the rough state, if some pieces were finisbed much better and softer than others, it was attributed to lucky chance, the patron divinity of the ignorant. Mr. Bakewell proved that the hardnefs of English wools does not depend on the nature of the food, or even entirely on the breed; it is the effect of the soif acting on the surface of the fleece. The wools from chalk districts, or light dry calcareous soils, have the natural yolk or moisture absorbed by the particles of calcareous earth that penetrate the fleece, and the wool is thereby rendered hard. The same effect is produced on the skin where time is used; it may also be produced by keeping wool for a longer or shorter time in a dry hot temperature; and when wool has been so dried, no process will restore it to its pristine softness. On the contrary, wools grown on rich loamy argillaceous soils are always distinguished for their softness. The quantity of grease or yolk in the fleece has a considerable degree of influence on the softness of Merino wool, the pile being to close as in a considerable degree to prevent the earthy particles from penetrating the fleece; but all English fleeces the wool is grown thinner on the skin, and admits the more easy access of the absorbent particles. Exposure to the direct rays of a summer sun has also a tendency to injure the soft quality of the wool. We shall have occasion to refer to the methods recommended by Mr. Bakewell to improve the softness of wool on foils naturally unfavourable to its growth.

Of fine European wools, the Saxony generally possesses a greater degree of softness than the Spanish, which we believe to be owing to the sheep being less exposed to the action of light and heat. The native fine Italian wool, before the introduction of the Merino race, possessed a considerable degree of softness, judging from wools which we have seen from thence, but they were deficient in foundness, and not true growen. The wools on the chalk soils in the southern and eastern side of England are generally hard, except, as in Kent, where the chalk is covered by thick argillaceous beds. Nottingham forest, Charnwood forest in Leicestershire, and some parts of Shropshire, produced not the finest, but some of the finest wools in England before the late inclosures. The Cheviot hills in Cumberland are not pelted by the finest woolled English sheep, but their fleeces possess a degree of softness exceeding any from the other districts of England, and they are rendered soft by artificial means, which we shall describe. It is still somewhat uncertain, whether there are two distinct breeds of sheep, from which the fine shawl wool of India are grown; or whether one species of the animal which yields it is not to be elided with the goat. The fleeces from India, which we have seen, are grown on a very small sheep; close to the skin, there is a wool as soft as the finest fur; this is covered by long coarse hairs growing through it. When the wool is once shorn, the separation of these hairs from the soft
wool is a work of extreme difficulty; but on the back of the sheep we believe the separation can be made with great ease. The softness of the Indian wool is not even dimly approached in the very softest Merino fleeces from Saxony and Spain; this may be proved by comparing the finest camel's wool from Saxony with the flannels or chaffy cloth of India. The ancient Tarentine sheep, called by way of excellence 'molles oves,' were treated with peculiar care by the Romans, and clothed in skins, which we believed was intended to preserve the softness of the wool, as it is still practiced in some parts of Asia for that purpose. In Europe no experiments have been made directly to improve the softness of wool, though wool approaching in softness to that of India would be a most valuable acquisition to our manufactures. To be convinced of this, it need only be flated, that the yarn from Indian wool has been fold here at three guineas per pound, not on account of the superior fineness of the spinning, but for the softness of the wool. For coarse goods, indeed, such as blankets, carpets, and clothes called duffells, raised with a hairy pile, a considerable degree of hardness or elasticity of the fibre is an advantage; but in all the finer articles of the woollen or worsted manufacture, the opposite quality is of great value.

The felting property of wool is intimately connected with its softness, the softest wools having the greatest tendency to felt, and the hard wools are all defective in this respect. The felting property appears to depend on a peculiar structure of the surface of the fibres, by which they are disposed to move in one direction more easily than another. This is perceptible in drawing a hair through the fingers, first from the end to the point, and again from the point to the end; in one direction the hair feels perfectly smooth, in the other direction a peculiar roughness is felt. The cause of this is supposed to be owing to the surface of the fibres having lamina, like the scales of fishes, with the edges laid over each other. Indeed in the fur of some animals we have observed with a powerful microscope, that the surface is composed of lamina laid over each other, resembling the arrangement of the leaves of the artichoke. On this property the process of hat-making depends; the short fibres of the fur being repeatedly compressed, moved and interlocked with each other, so as to form a compact substance; this motion is further aided by heat and moisture. A similar process takes place to a certain degree in cloth subjected to the strokes of a fulling-mill; the fibres cohere, and the piece contracts in length and breadth, and its texture is rendered more compact and uniform. This process is essential to the beauty and strength of woollen cloth; and it is observed, that the softer wools felt in much less time than the harder, and form a closer pile on the surface of the cloth, on which account it is a common practice to mix a certain quantity of soft wool with the hard, to enable the former to felt with more facility.

The length and foundness of the staple of clothing wool is the quality next to be considered. By the staple of wool is meant the separate locks into which the fleece naturally divides in the skin, each lock consisting of a certain number of fibres, which collectively are called the staple.

The belt length of staple for fine clothing-wool, if found, is from two to three inches. If it be longer it requires breaking down to prepare it for the processes of carding. Saxony wool, being generally more tender than the Spanish, and more easily broken down, is sometimes four or five inches long; but as it works down easily, it is preferred, on account of the length of its staple, for such goods which require fine spinning, as cambric, taffeta, and shawls. Much of the English clothing-wool of a middle quality is grown longer than is desirable for the purpose of the clothier, and when found is thrown out for the hairy trade, if the demand for the latter be great. As the grower could not shorten the length of the staple without diminishing the weight of the fleece, he has no motive to induce him to grow shorter wool; but the object might be obtained with much benefit to himself by securing twice in the year, once the latter end of April, and again the latter end of August; the wool would then be grown of a suitable length for the card, and from experiments which have been made we believe the weight would exceed what can be obtained from one clip; the increase would not be less than fifteen per cent., and the condition of the fleece thereby improved.

The foundness of the staple in clothing-wools is not so important as in combing-wools; but for some kinds of cloths which injure the wool, it is particularly desirable that the fibre should be found and strong; this is judged of by examining the staple and pulling it by both ends. The foundness and strength of the staple depend primarily on the healthy state of the animal, and on a sufficient supply of food. The staple on some parts of the fleece will always be more tender than on other parts, and by mixture they tend to form a dense pile on the surface of the cloth.

The colour of the fleece should always approach as much as possible to the purest white, because such wool is not only necessary for cloths drest white, but for all cloths to be dyed bright colours, for which a clear white ground is required, to give a due degree of richness and lustre. It is probable that all sheep's-wool is a sort of a black or reddish colour; the latter is often referred to by the ancients. Before the invention of dyeing, coloured wool must have had a preference to white; but after the art of communicating beautiful colours to the fleece, white wool would be in the highest demand, and those fleeces which had white fleeces would be selected to breed from. The most ancient flocks of sheep which we have any record of are those of Laban and Jacob, described in the book of Genesis. The fleeces appear to have been principally brown, or spotted and striped, which was in all probability the general colour of the flocks throughout that part of Asia. We learn that in the course of twenty years a great change was effected in the colour of a large portion of the sheep of Laban; though Jacob appears to have concealed from his father-in-law the method by which this change was effected, we are expressly told in the (heqel) that it was by crossing with rams which had fleeces of the colours required.

Dark-brown or black woollen sheep are not uncommon in many parts of the European flocks, but fuch wool being of less value than the white, these sheep ought always to be expelled. Some of the English fine-woollen sheep, as the Norfolk and South-Down, have black or grey faces and legs. In all such sheep there is a tendency to grow grey wool on some part of the body, or to produce some grey fibres intermixed with the fleece, which renders the wool unfit for many kinds of white goods; for though the black hairs may be too few or minute to be detected by the woolster, yet when the cloth is flaved they will become visible, forming reddish spots, by which its appearance is much injured. The Herefordshire sheep, which have white faces, are entirely free from this defect, and yield a fleece without any admixture of grey hairs. We have no doubt that by carefully rearing those sheep from the South-Down flocks, in which the grey is most apparent, this defect might be gradually removed. It is particularly desirable with respect
to these sheep, as the wool grown on chalk foils, though
less soft than on other foils, is generally whiter, and better
suited to such goods which require the procers of bleaching
or duning, and do not require to be so much fulled as many
other cloths.

The ancients were so well aware of the necessity of ex-
pelling dark-coloured wool from their flocks, that in select-
ing the sheep to breed from, they did not truft to the colour
of the fleece alone, but carefully examined the mouth and
tongue of the ram, and if the leaf blackness or swarthines
appeared he was immediately rejected; and though some
moderns have doubted the ufe of this precaution, we believe
it was well founded.

" Illum autem, quanvis aries fit candidus ipfe,
Nigra fubfét udo tantum cui lingua palato,
Rejice, ne maculius vellera pullus
Naícentem."
Vir. Georg. iii.

Pliny also states, that particular attention was on this
account had to the colour of the mouth. "Arietum max-
ime spectantur ora." We are informed that this kind of
inspection takes place in the Spanish flocks at prent, a
practice in all probability derived from the Roman shep-
herds, as we believe the flock to have been from thofe of
Italy, or the Tarentine breed. The colour of the foil on
which fheep graze, if very dark or red, communicates to
the wool a tint more or less strong, which is indelible, and
renders fuch wool fepar for cloths or hofery goods that
are to be finifh'd white; for though the colour may be
improved by duning, yet on washing the cloths, theyfoon
return to a brownifh or yellowifh tint. The tint from the
foil is, however, rarely of fufficient strength to be re-
garded for dyed goods, excepting for exceedingly light
colours.

The cleannees of wool is principally regarded by the pur-
chafers, as it affects the weight. To the grower thofe fleeces
are generally the moft profitable, as are well filled with the
greafe, or yolk as it is called, becaufe it keeps the wool
in a found flate, and improves its softnefs. It ought, how-
ever, to be washed out as much as poifible before it is ex-
poled to fale. The fleeces of the Merino fheep are more
plentifully fupplied with yolk than thofe of any of our
native fine-woofled breeds; indeed it is fo abundant, that
the Englifh mode of washing on the back of the fheep will
fcarcey produce any effect upon the fleece. The yolk or
greafe in the fleece appears, from the experiments made
upon it by M. Vaquelin, to be a native foap, confifing
principally of animal oil combined with potath. It is moft
ripofully produced in thofe breeds which grow the fijeft
and fofteft wool, and is always moft abundant on thofe parts
of the animal which yield the fijeft parts of the fleece.
To this fubject we fhall again refer in treating of the improve-
ment of wool. This yolk, though fo beneficial to the wool
in a growing flate, becomes injurious to it when fhorn; for
if the fleeces remain piled in an unwafhed flate, a fermenta-
tion takes place, the yolk becomes hard, and the fibre is
rendered hard and brittle. This effect takes place more
rapidly in hot weather. The Spaniards remove this yolk in
a great meafure by washing the wool after it is fhorn and
forted. In Saxony fine-woofled fheep of the fame race are
washed in tubs with warm water, foap-lees, and urine, and
afterwards in clean water.

In England the wool is washed on the back of the fheep
by immersing the animal in water, and fqueeving the fleece
with the hand. From these different modes of washing, the
wool is left more or lefs pure. Mr. Bakewell, in bis Ob-
servations on the Influence of Soil and Climate on Wool, has
given the following table, containing a fatement of the quan-
tity of neat wool in every hundred pounds, taken on an
average of each fort, and supposing each to be free from
lumps of pitch employed in marking the wool, and cleared
from what are called the dog-locks. The firft column repre-
sents the average weight after the wool has been fcored
perfectly clean with foap and water, and dried; the fegond
the amount of wafhe.

<table>
<thead>
<tr>
<th>Weight of Wool washed on the Sheep</th>
<th>Amount of Waste</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 lbs. of English wool washed on the sheep's back</td>
<td>10</td>
</tr>
<tr>
<td>Ditto Saxony fleece-wool</td>
<td>90</td>
</tr>
<tr>
<td>Ditto Spanish R, or refine</td>
<td>80</td>
</tr>
<tr>
<td>Ditto Spanish and Portugal unwashed</td>
<td>75</td>
</tr>
<tr>
<td>Ditto English fleeces unwashed</td>
<td>65</td>
</tr>
</tbody>
</table>
| Ditto lightly greased wools of Northum-
berland washed on the sheep's back | 55 |

Hence it is obvious, that the fitate of the fleece with
repect to cleaneenes is an object of great importance to the
wool-buyer. The Englifh Merino fheep, from the diffi-
culty of washing the wool on the sheep's back, have ge-
nerally been fhorn in an unwafhed flate, and the wool
offered for fale in this flate. The purchasers were fre-
quently unacquainted with the great amount of the wools
it would suffer by washing, and were much disappointed at
the refult. This circaftance, we conceive, more than any
other, tended to prejudice the manufacturer againft the
Anglo-Merino wool. The wool is also injured by remain-
ning in the greafe, as we have before flated, and though this
has been contradicted, we have no hesitaton in afcertaining
the fact from our own experience. Indeed the French manu-
facturers of fine cloth affert, that the beft wools from Spain,
though cleared in a great meafure from the yolk, yet till retain
fufficient to injure the wool if it be fuffered to grow old when
it is packed, the yolk becoming rancid and hard, and com-
muñicating the latter property to the wool. We have fre-
quently observed this effect in the wools from Portugal, that retain
a greater portion of the yolk than thofe from Spain.

After wool has been washed in the ufual manner prac-
tified in England, and piled or packed, a certain procefs
takes place in eight or nine weeks, called fweating. This is
well known to wool-dealers and manufacturers, but has not
been before noticed by any writer that we are acquainted with.
It is evidently an incipient fermentation of the remaining
yolk; and the inner part of the pack or pile becomes fen-
fibly warm. This procefs produces a certain change in the
wool, whereby it becomes in a better condition for manu-
factoring, being what is called in the north of England lefs
fuzzy. This effect results from a diminution of the natural
efficacy of the fibre.

When this fermentation takes place in unwafhed wool, it
proceeds farther, and injures the colour and foundnees of the
flaple or fibre. A fimilar effect is produced in wool or
cloth which has been oiled, and remains fonie time in an un-
figured flate. Inflances of Spontaneous combustion from
heaps of refuse wool remaining in a greatly flate have been
known to occur, and occafion the moft feriouf accidents in
woollen factories.

The weight of the fleece is an object of great im-
portance to the grower. It is generally suppofed by the
Englih wool-dealers, that an increafe of weight implied an
increafe of coarfenes; indeed the words coarse and heavy are
confidered by them as fynonymous, but this is not abso-

The method of measurement adopted by Mr. Luccock might be sufficiently correct with the deduction of one-fifth, were the instrument always used by the same person, and a similar degree of pressure given in each experiment; but as this is required, it becomes uncertain in its results, and inadequate to practical purposes.

Dr. Parry's method of measurement is effected with an instrument similar in principle to the lamp micrometer of Dr. Herchel, of which an account is published in the Philosophical Transactions for 1782. (See Micrometer.) An object of a known diameter being placed in the focus of a compound microscope, and strongly illuminated, a piece of white paper is placed horizontally at some distance beneath it; then looking through the microscope with one eye, and keeping the other steadily open, you will see the object apparently projected on the paper, which is to be measured, while viewing it, with a pair of compasses. Divide the length of the image so measured with the known diameter of the object, which will give the magnifying power of the microscope. This being found, place the object you wish to measure in the focus, and projecting its image on the paper as before, measure it with the compasses, and divide the result by the magnifying power, which will be the real magnitude of the object required.

The light of a lamp is to be preferred to day-light, and the fibres to be measured are to be stretched on a glass, and waxed down at both ends. The under side of the glass should be blackened with Indian ink, except in three parts, the middle, and near the two ends. The unblackened spaces being placed in the focus of the microscope, ten or more filaments may be examined and measured successively, both in the middle part of the glass, and near the ends, which will give the diameter of the filament at the upper and lower end of the staple, and in the middle. Each lock of ten filaments being thus examined in three different parts, the mean of the three measurements must be taken for the mean diameter of each filament, and the mean diameter of the ten filaments may be taken for the fineness of the whole lock.

In place of the blackened glass, we would recommend a thin slide of ivory or brass, about five inches in length, and half an inch in breadth, with three transverse flits or openings, one in the middle, and the two others about three-fourths of an inch from each end. On this slide the filaments may be stretched, it will not be liable to break, and the edges of the filaments will be more correctly defined than when a plate of glass is placed under them.

The farther the paper is removed from the eye, the larger will be the apparent space covered by the image of the object, but it must not be too far for the hand to measure it with compasses. But if in place of the compasses we have a fleet of pale-board graduated into minute divisions from a black line upwards, and a sliding index be adjusted, the pale-board may be placed at a much greater distance, the observer adjusting the slide, until the edge of it and the black line coincide with both edges of the filament. An

In the case; a fleece grown upon the same animal may be increased in weight either by the fibres becoming coarser, or by their being grown longer, or by a greater number of fibres being grown in the same skin. To the wool-grower it can never answer to increase the weight of the fleece on small fine-woollen sheep, by growing the wool coarser; if this be his object, the long-woollen breeds of sheep are to be preferred. He may produce wool somewhat longer by increasing the quantity of food; but it generally lores something of its fineness, and is less suitable for the cloth trade. He may, however, increase the weight considerably by selecting such breeds as grow the wool close upon the skin, and are thickly covered with wool over every part of the body. In this respect, the Merino sheep have greatly the advantage over any of the native breeds of English sheep; many of them yielding from three to four pounds of pure wool, whilst the finest English fleeces rarely exceed two pounds, and would lose one-fourth of this weight when brought to a pure state by scouring. It has been doubted whether all sheep's-wool, when clean, possesses the same specific gravity; but admitting there may be some variation in the wool from different places, we conceive that it is too minute to deserve the attention of the wool-grower or manufacturer.

The filaments of fine wool being so minute, it requires an eye habituated by long experience to appreciate the relative fineness of two piles, which may differ in value as much as twenty-five per cent. Even those who have been long practised in such examinations find it difficult to form immediately a correct opinion of the fineness, if they are removed for a few weeks from all opportunity of viewing wool. It is not surprising then that the wool-grower, who only directs his attention to the subject during one part of the year, should often be unable to judge whether his wool has improved or not since the preceding summer. On this account it would be highly desirable that some easy and correct method of ascertaining the diameter of the micrometer could be invented, which might enable the observer to decide this with certainty. Mr. Daubenton employed a graduated scale, adapting it to the eye-piece of a compound microscope; but his method does not admit of accuracy. Mr. Luccock made use of a more simple instrument, which we have seen; it consisted of a lens about half an inch in focal length, adjusted to a graduated scale. On this scale a number of fibres were stretched and compressed by a slider and screw into a given space; the filaments covering this space were then counted by the aid of the lens, and a number of measurements being taken of the same lot, the mean of the whole was supposed to give the correct diameter of the filament. In this method, however, some of the filaments must unavoidably overlap part of the others, on which account a greater number will be seen in a given space than there would be the whole diameter of each fibre visible. The error resulting from this may be corrected at one-fifth. Thus Mr. Luccock makes the best English wool to measure the fourteen-hundredth part of an inch, which is finer than the best Spanish, as measured by Dr. Parry, by a more accurate but more laborious method. According to Mr. Luccock, a sample of moderately fine Spanish wool reached to the sixty-one-hundredth part of an inch; according to Dr. Parry, the very best Spanish is not finer than the fourteen-hundredth part of an inch.

With the above deduction of one-fifth, which we believe to be a near approximation to correctness, the diameter of the fibres of the best English wool, as inferred in the usual method, will be nearly as follows:

<table>
<thead>
<tr>
<th>Parts of an Inch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prime</td>
</tr>
<tr>
<td>Choice</td>
</tr>
<tr>
<td>Super</td>
</tr>
<tr>
<td>Head</td>
</tr>
<tr>
<td>Downrights</td>
</tr>
<tr>
<td>Seconds</td>
</tr>
<tr>
<td>Abb</td>
</tr>
<tr>
<td>Fine livery (variable)</td>
</tr>
</tbody>
</table>

The diameter of the best English wool, as measured by Mr. Luccock, at one-fifth, is slightly greater than the mean diameter of the filament, as determined by Dr. Parry, by a more accurate method; but the difference is very small. In the middle part of the fleece, the best English wool is very much finer than the best Spanish; but in the outer part of the fleece, the differences are trifling.
horizontal position for the microscope will be the most convenient, illuminating the object with a lamp and lens. In this way, the apparent diameter may be greatly increased, and we think the observations might be made with greater ease and accuracy.

By the above method the diameter of very minute filaments may be ascertained, and minute differences detected, which the unaided eye is unable to detect. We are aware, however, that it requires some address and time to enable the observer to manage the instrument, on which account it cannot, we fear, be made generally useful.

The following admeasurements of different fine wools were taken with Dr. Parry's instrument; the first column represents the outward end of the filament, the second the middle, and the third the bottom, in fractional parts of an inch; the latter column the mean of ten filaments of the same wool.

TABLE of comparative Diameters of the Filaments of various Clothing Wools, by Dr. Parry.

<table>
<thead>
<tr>
<th>Wools</th>
<th>Outward End</th>
<th>Middle</th>
<th>Inner End</th>
<th>Mean</th>
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<td>1/32</td>
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<td>1/64</td>
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Long Wool, or Combing Wool, being prepared for spinning by a process entirely different from that of short or clothing wool, and the pieces made from it being finished in a very different manner, the qualities most required in this kind of wool are length and soundness of the staple, without which the fleece is unsuited for the comb. The fineness of the hair is a secondary quality, required only in certain kinds of goods. The wool-comb is an instrument of simple construction, consisting of a wooden handle, with a transverse piece or head, in which are inserted three rows of long steel teeth. The wool, which is to be combed after being cleaned, scoured, dried, and oiled, is first drawn upon these teeth with the hand, until the comb is sufficiently loaded. It is then placed on the knee of the comber, and another comb of a similar kind is drawn through it, and the operation is repeated till all the hairs or fibres are combed smooth in one direction. This operation requires considerable strength, but the comb being previously heated, and the wool thoroughly oiled, facilitates the process. When completed the combed wool is drawn off with the fingers, forming what is called a 'fleer'; the shorter part of the wool sticks in the teeth of the comb, and is called the 'noyl': this is sold to the clothiers.

From the above description, it is evident that if the staple of the wool be not found, the greater part of it will be broken by the process of combing, and form noyls. The staple must also have a sufficient degree of length for the combs to operate upon it. Length and soundness of the staple are therefore the most essential and characteristic qualities of combing-wools.

Long wools may be claffed into two kinds: first, those suited for the manufacture of hard yarn for worsted pieces; and second, those suited for the manufacture of soft yarn used for hosiery. The former require a greater length of staple than the latter. The first may therefore be called long combing-wool, and the latter short combing-wool; between these there are gradations of wool, which may be applied to either purpose.

Long combing-wool should have the staple from six inches to eight, ten, or even twelve, in length. Before the recent improvements in spinning by machinery, a very great length of staple was considered as an excellence in long combing-wools; and on this account the hog-wool, or the first fleeces from the sheep which had not been shorn when lambs, was more valuable than the wether wool from the same flock, and bore a higher price than the former, by at least fifteen per cent. Since that time the wether wool has risen in relative value on account of the evenness of the staples, each lock being nearly equally thick at both ends; but the staple of hog-wool is pointed, or what is technically called 'spirey'. Eight inches, if the wool be found, may be regarded as a very proper length for heavy combing-wools. The longer stapled wool was formerly worked by itself, and used for the finer spun yarn, or mixed in small quantities with the wether wool, to improve the spinning. It is found that an equal length of staple contributes to the evenness of the thread when spun by machinery, and a very great length of staple is rather injurious than otherwise in the process of machine spinning. To the wool-grower, however, it must always be desirable to increase the length of his heavy combing fleeces, as he thereby materially increases the weight; and we have yet learned that the price has ever been reduced on this account, for if the wool be too long for some branches of the worsted manufacture, there are others in which it may be worked with advantage.

The length of the staple may be increased by a plentiful supply of nutritious food. The same effect may also be produced by letting the wool remain a longer time on the sheep before it is shorn. We have seen a staple of Lincolnshire wool, which was twenty inches in length: it had grown two years without shearing. This, however, would be unattended with any advantage to the grower. The more frequently sheep are shorn, provided the wool is sufficiently long, the greater will be the weight grown in a given time on the same animal; for, from observations which we have made, we are satisfied that wool is grown more rapidly immediately after the sheep are shorn than at any other time.

Length of staple in wool depends primarily on the breed, but may be more affected by culture than by any other qualities of the fleece. The soundness of the staple may be easily judged of by pulling both ends of it with the fingers with considerable force. In weak or unformed wool the staple easily breaks in one or more parts, and on observing it, it will be seen that the fibres are much thinner in the part which breaks. This is occasioned either by a deficient supply
Wool.

Short combing or hosiery wool requires a different length of staple, according to its fineness: for the better sorts, the staple should not be shorter than four or five inches; the lower sorts may range as high as eight inches. A greater length than this is not desirable for any kind of soft worsted. What has been said of the finenesses and fineness of staple required for long combing-wool, applies equally to the hosiery wool, but in this the fineness of the hair and finenesses are of more importance. Most of the fleeces which yield fine combing-wool produce nearly an equal quantity of short wool, which is thrown in the same manner as the regular clothing sorts. The combing sorts for the hosiery are generally called,

- Super matching
- Fine matching
- Fine drawing
- Altered drawing
- Brown drawing
- Saycalt

The names of these sorts derive their origin from ancient processes of the manufacture, with which we are unacquainted at present. The lower sort, or saycalt, was probably at first the coarse combing-wool, thrown out for the manufacture of lays, of which we have frequent mention in the earliest history of the woolen trade in England. The relative value of these sorts, compared with each other, varies according to the demand for the finer or coarser kinds of hosiery, and is also affected by the clothing trade. When any clothing sort which ranges in fineness with one of the combing sorts is in great demand, the wool-sorter will break down the shorter combing-wool of this sort, and throw it to the clothing-wool, which enhances the price of the former by making it scarce. The fineness of these sorts out of the belt combing-wools, stated numerically, as compared with clothing sorts, will be nearly as under, in the fractional parts of an inch.

- Super matching
  - Fine matching
  - Fine drawing
  - Altered drawing
  - Brown drawing
  - Saycalt

Most of the belt sorters throw out the hog combing-wool from the belt sorts, making a superfine hog for the bombazine and other kinds of worsted, which does not require yarn so finely spun as for hard yarn.

As all the different sorts of short combing-wool, together with several sorts of clothing-wool, will frequently occur in one English fleece, it is obviously the interest of the grower that his fleece should produce as great a proportion of the belt sorts as can be done without materially diminishing the weight.

Skin Wool, or Pelt Wool, is the wool separated from the skins of slaughtered sheep by the fellmonger. The quantity of this wool, in a country like England, where so much animal food is consumed, is very considerable, and has been estimated at near 50,000 packs of 240 lbs. per annum, for England and Wales. Soon after shearing, the skin-wool is very short to be worked by itself, and is generally kept and mixed in with the longer wools. The proceeds by which wool is separated from the skins has a tendency to make it hard, and destroy or injure its felting or milling property, on which account short-skin wools are seldom used for the manufacture of cloth, but more generally for flannels, ferges, and those kinds of goods which require little or no milling; the
the finest kinds are much used for stockings made of yarn from carded wool. In the spring, when the wool on the skins has acquired a considerable length, it is thrown into combing forts; the finer kinds are used for knitting hosiery yarn, and the coarser for hard yarn for the weaving of ferges and other goods, having a warp of combed and a weft of carded wool. The value of skin-wool is half equal to that of fleece-wool of the same degree of length and fineness, owing to the felting property being injured, which renders it more unfit for the manufacture of woollen cloth.

Lamb's Wool.—The wool of the lamb is, with certain exceptions, softer than that of sheep's wool, from the same flocks. It possesses the property of felting in a remarkable degree, and on this account is principally manufactured into hats, except skin lamb's-wool, which losing its felting property in a great degree, is employed in the manufacture of flannels and woollen yarn for lamb's-wool hosiery. In the northern parts of Europe, the lambs of some of the breeds of sheep possess a fleece so delicately soft, that it constitutes a most valuable fur, being dressed on the skin, and used as a costly article of attire. According to Pallas, the inhabitants of the Caukas and Podoli, as soon as the lamb is dropped, (which comes into the world with a pretty wavy skin, even without the assistance of art,) to augment its beauty, and make it bring a higher price, few it up in a framework of coarse linen thift, so as to keep up a conftant gentle preffure on the wool, pouring warm water over it every day to make it soft and fleck; only letting out the bandage a little from time to time as the animal increases in size, but still keeping it tight enough toeffect its purpose, which is to lay the wool in beautiful glossy ringlets, and thereby produce a delicate species of fur in great request for lining clothes and morning-gowns. By this treatment, the fleece of the fine soft wool which rifes in the infancy of the lamb takes a handsome arrangement; and the animal is killed younger or older according to the species of fur intended to be produced; from a short glossy nap, like that of the thinnest for the purpose mentioned above, to a warm thick fur for a winter great-coat. The frill of these fur in estimation and price is a fine black, that looks like silk damask; an inferior black fur comes next, much thicker, used for pelisses, or goutes, as the upper winter garment worn out of doors is called; and the leaf in estimation is the white, except it be of a very pure colour and silky appearance, where it is a rival to the frill; especially for night-gowns, a very common drefs both morning and evening among the Russians; particularly in the interior parts of the empire.

The Boucharian sheep, as described by Pallas, grows a compact, soft, and elastic wool, which is elegantly formed into frizzled ringlets. In the lamb, the wool is formed into delicate little circular waves, as if prefléd close to the skin by art; but when taken from the mother, or killed immediately after birth, they are full more beautiful, and often elegantly marbled with feathered waves, like silk damask. These three furs are the finest and most precious of the kind known to Europe and the East; they are brought to us by the Boucharian Tartars and Persians, who fell them dear. The most prized are, the blue, the black, and the silver grey; but of the uniorb lamb-skins, as the fine glossy thin furs are called, so much resemble silk damask, the fine black is dearer, and most esteemed. To obtain these valuable furs, the Boucharian Tartars purchase whole flocks of male lambs just dropped from their mothers: as to kill a female till the age of breeding is held as a kind of crime by all Tartar hordes; such is their reverence for an animal which contributes their greatest riches, and the propagation and care of which are the great business of their lives; so that all the fur we see of this species sold by the Tartars are from young rams. The Boucharians are of opinion, that art is necessary to preserve these furs in their greatest beauty; and under that idea, keep the lambs under shades, &c. during the meridian ardour of the sun; but Dr. Pallas has reason to think, that these precautions are useless, as he observed that the same variety of sheep produced the same fine hues equal in every respect, without any fort of care, in the hands of the Kirgitz Tartars.

It is very remarkable that the lamb's-wool, in many of the Merino flocks, is coarser than the sheep's-wool. In some of the flocks, the lambs are at first covered with coarse hair, which falls off afterwards, and they produce the finest wool.

Wool from other animals besides the sheep is employed in manufactures, and spun or woven into fabrics of different kinds, either unmixed or mixed with sheep's-wool. The goats of Thibet, which grow the fine shawl wool, produce it as a fine down at the bottom of the long coarse hair, with which the animals are covered. Many of the common goats in Europe grow a similar down, which, by cultivation, might become a valuable article of commerce. It is not, however, yet clearly ascertained, whether the shawls and shawl cloth of India are all manufactured from goat's-wool; part of it appears to be made from sheep's-wool peculiarly soft and fine. The Angora goat grows a hair extremely fine and silky, which is much used in some of the Frenchworsted goods mixed with silk. This goat is properly a long-woollvd animal. Dr. Adéon says, that the Angora goat will prosper and preserve its peculiarities in France and Sweden. The wool of the vicunna, called Vigonia wool, is generally of a reddish-fawn colour; it is peculiarly soft and silky, but intermixed with long coarse hairs, which are very difficult to separate. (See Vicuna.) From the lama and pacos of Peru a stronger and longer lapped wool is obtained, which is sometimes white. Under a liberal government which protected and encouraged commerce, we have no doubt the fleeces of these animals might be greatly improved, and would become an article of great value. The wool from the yak of Tartary, and the mult of Hudson's bay, has yet received little attention. We have seen flocks made of the latter, and which are worn in that country; the wool was soft but not fine, and much intermixed with long coarse hairs.

The quantity of sheep's-wool annually grown in England and Wales is estimated, by persons in the wool trade examined before the house of commons in the year 1800, at six hundred thousand packs. Mr. Luccock, in his Treatise on Wool, seems to consider this estimate as greatly exceeding the real amount, and has given an estimate founded on the supposed extent of surface pastured by sheep, and the quantity of sheep per acre in each county. This table we subjoin, as the only attempt that we know of to determine the quantity on certain data; though we consider it only as an approximation to the truth, and are inclined to believe that the quantity is not the real amount. Such is also the opinion of the most intelligent persons in the wool trade, whom we have had an opportunity of consulting.

From this table, it will appear that the total amount, including skin-wool and lamb's-wool, is somewhat short of four hundred thousand packs, which is probably one-fourth below the true quantity, could it be ascertained. Mr. Luccock is inclined to believe that the flocks of sheep in England and Wales are not so numerous as formerly, but he says the number of Ireland and Scotland are rapidly increasing. Even in England and Wales, he says, we have
Wool.

More than three millions of acres capable of being improved, and carrying a more numerous flock. We have two millions of sheep whose fleeces are scarcely wool, and which might be brought to contribute their share to support the woollen manufacture, and to increase the wealth of the country.

It may be proper to remark, that the quantity of wool grown annually in England is more variable than is generally supposed, owing to the variable temperature of our climate. In long-continued and severe winters, the sheep not obtaining the same quantity of food, and being also rendered less vigorous by the cold, do not grow so much wool as in milder seasons. The difference between the weight of the fleeces grown in severe and in very mild seasons, may be stated at one-fifth of the whole annual clip: indeed we believe it exceeds that proportion. About the year 1700, the annual value of English wool was estimated at two millions sterling. If we suppose the average price at that time to have been eight-pence per pound, or eight pounds per pack, this will make the total weight of wool two hundred and fifty thousand packs. Indeed when we consider the improved state of our agriculture, the great increase of our population, and of our woollen exports, we may fairly state the present weight of wool grown to be double the amount of what it was at the period referred to. In a subsequent part of this article, it will be seen that the cloth manufactures of Yorkshire, principally from English wools, have increased eight-fold in the last eighty years; and though the woollen manufactures have removed from some other situations, yet the great increase on the whole in England cannot be doubted. Since the date of Mr. Luccock's table in 1805, in consequence of the high price of long combing-wool, the growers have paid more attention to the weight of their fleeces, and many who had rendered their fleeces lighter by exchanging the Lincolnshire for the Leicestershire breeds of sheep, have since been reverting to the former breed, or rather to a mixed breed, endeavouring to combine the improved form of the Leicestershire sheep with the heavy fleece of the Lincoln. The quantity of long combing-wool grown annually is greater than it was even ten years since; the high and increasing price and demand operating naturally as a premium for its cultivation.

Table I.—Shewing the Produce of English Long Wool.

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<tr>
<th>District</th>
<th>County</th>
<th>No. of Acres</th>
<th>No. of Sheep</th>
<th>Weight of Fleece</th>
<th>No. of Packs</th>
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3939563  4153308  131794

Slaughtered

1176770 Sheep
196128 Producing long-skin wool 5720 Packs.
Carriion wool 286

5434

Neat Total  137228

Table
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<th>Weight of Fleece</th>
<th>No. of Packs</th>
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Packs Skin Wool.

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WOOL.

The whole of the imported wool, with scarcely an exception, is worked on the card, none of it being suited for the comb. The coarser kinds are principally employed for carpets, &c.; and the fine from Spain, Germany, Portugal, and France, supply our manufacturers of superfine broad cloths, caftlemes, &c. So large a portion being of the finer kinds, the total value cannot be less than one million and a half pounds sterling.

Wool of New Holland.—The annual value and amount of the fine wool imported into England for our own manufactures being so great, we must purely applaud the meritorious exertions of those who attempt to supply the demand with the produce of our own country, or of our dependent colonies, and more particularly if they can raise this supply from parts where no wool was before grown. In this view, it cannot fail to be highly interesting to learn, that the exertions of one enlightened agriculturist have been eminently successful in spreading over an immense region dependent on England the very finest-wooled sheep, where the wool had never before yielded any produce serviceable to civilized man.

John Macarthur, esq. descended from an ancient family in Argyleshire, captain in a regiment then commanded by general Grose, went to New Holland in 1789. Fortunately for the future prosperity of the colony, his active spirit of inquiry and enterprise led him to direct his attention to the natural advantages which the soil and climate presented to the agriculturist, and having by purchase and grants obtained a considerable tract of country, he quitted the service in 1793, and commenced his farming operations. His flock at first continued only of a few oxen and thirty Bengal eues, growing a coarse kind of wool or hair. About the year 1795, he obtained from captain Kent, of the Royal Navy, one Merino ram and two ewes, purchased from the Dutch governor of the Cape of Good Hope. With these he began to cross his coarse-haired sheep, and to select the finest-wooled progeny to breed from. Having occasion to return to England in 1802, he brought over specimens of his wool, which were shown to a body of the clothiers from the west of England, then in London on public business, who were so sensible of the advantages which might result from encouraging the growth of fine wool in the colony, that they presented a petition to the privy council, by whom Mr. Macarthur was examined. His plans being approved, the privy council recommended the secretary of state for the colonies to give him an additional grant of land, in a tract of country, from its fertility, called the cow-paftures, forming part of Camden county. On his return he took with him three Merino rams and two ewes, purchased from his majesty's flocks; and thus encouraged, he proceeded with rapid steps in the increase and improvement of his flocks, the climate being every way suited to secure the healthy condition of the sheep, and preserve the fineness of the wool.

The numbers increase four-fold every five years, so that his flocks already amounted to about four thousand sheep and lambs, including the fine and mixed breeds, when the unfortunate disputes with governor Blight, and the subsequent arrest of the latter, obliged Mr. Macarthur once more to return to England, and in some degree interrupted the progress of improvement. In 1817 his flocks had increased to about seven thousand, and the wool which has been sent to this country at different times, is become an important source of profit, the better fort being equal to the best Merino piles from Spain or Saxony. What we have seen more nearly resembles the latter, and were they both in the same flate of cleanliness, the most experienced eye could not discern any difference between them in fineness of the hair, length of staple, foundness, colour, or other properties.

The
The wool has been hitherto washed on the sheep’s back in the English method, by which it is not rendered so clean as by the Spanish or German mode; but making allowance for the additional waste, its value is equal to that of the very best Merino wool imported from any part of Europe.

The quantity imported this year is about eighteen thousand pounds weight, and a further arrival is expected. The laudable example of Mr. Macarthur has been followed by other persons in the colony, and the total amount of wool sent thence this year is about fifty thousand pounds weight; and such is the spirit of agricultural improvement, that at the annual sales of sheep established by Mr. Macarthur, rams and ewes have been sold at from ten to thirty guineas each. Though the absence of Mr. Macarthur impedes the progress of improvement, yet this will be more than compensated by the valuable information he has obtained with respect to the management and improvement of his flocks, from observations made on the continent; and he has further benefited the colony by taking back with him a selection of olive-trees, vines, and oranges. The dryness and mildness of the climate of New Holland, and the almost total absence of briars and underwood, are extremely favourable to sheep. His flock is divided into flocks of about four hundred, with shepherds and Spanish dogs to each. Under these propitious circumstances, and as the flocks double in number every thirty months, we may anticipate, that in the course of twenty or twenty-five years, the importation of fine wool from this colony will be fully equal to the total amount at present imported into England from all the different countries of Europe. It might repay the exertions of this enlightened agriculturist, and of the British government, could they procure from India the animals, whether sheep or goats, which yield the peculiar soft wool for shawls. This would be a most valuable article, and is much wanted by our manufacturers.

There can scarcely be a doubt, that under the favourable climate of the British settlements in New Holland, all the Asiatic wool-bearing animals, particularly those of Cashmere and Thibet, might be introduced with every prospect of success. The coarse wool grown in the colony is chiefly manufactured in the country for domestic use. It is estimated that there are at present sixty thousand sheep in the colony, and a little perseverance and attention would suffice to change the coarse-wooled breeds into finer ones; a change which is at present rapidly taking place, and deferves the greatest encouragement, as wool is the only article of produce which the colonists have at present to export in exchange for British manufactured goods.

The Improvement of Wool depends primarily on attention to the breed of sheep, but there are various circumstances of soil, climate, and food, which are important to be regarded. The experiments that have been made in various parts of Europe within the last half century, have sufficiently removed the prejudice that long prevailed, respecting the impossibility of growing the finest clothing-wool in almost every part of the globe where sheep will subsist and thrive. It is different with the long combing-wools, to grow which in perfection, luxuriant pastures seem absolutely requisite, and these cannot be obtained under a parching sun, nor could the animal subsist in tropical climates, covered with such a load of wool as is grown on our sheep in Lincolnshire. Under such circumstances, an entire change seems to take place in the animal system; the long-wooled sheep become diseased and feverish, and only recover by casting the fleece, which is replaced by a coat of short hair. The rich pasture in England, and the opposite coasts of Flanders, seem more favourable to the growth of heavy combing fleeces, than any other country in the known world; and the Leicestershire and Lincolnsire sheep seem every way well suited to these pastures, and the prices of the wool obtained at present are sufficient to secure attention to its cultivation. At one period, indeed, during the American revolution, the price of long combing-wool not being more than about three-pence per pound, the growers turned their attention principally to the improvement of the car- cafe, and neglected the weight of the fleece. At present the price is about eighteen-pence, and the average weight being about eight pounds, the wool forms an important object, and the growers are endeavouring to increase the weight of their fleeces. For the common purposes of the worsted manufacturers, this wool is so well suited as to leave nothing further to be desired; and it is this which foreign manufacturers are so desirous to obtain from us. In many situations, however, where heavy long-wooled sheep are introduced, and where the soil is not sufficiently rich to grow it in perfection, it would be possible to grow a fleece weighing five or six pounds of very fine combing-wool, by crossing the long-wooled ewes with the Anglo-Merino rams. The increasing demand for finer goods, and the great improvement made in the spinning of combing-wool by machinery, make such a change desirable where the pastures are not sufficiently rich to bear the heavy long-wooled breeds of Leicesters and Lincoln.

In many cold and exposed situations it would be desirable to provide better shelter for the flocks; and the practice of greasing, hereafter described, might be introduced with great advantage, and would tend to preserve the sheep and improve the quality of the wool.

The experiments made on the fine-wooled sheep on a large scale in different parts of Europe, prove that the peculiarities of food and climate have comparatively small influence on the quality of clothing-wool, and that it may be grown equally fine in situations where the sheep are confined and kept on dry meat a great part of the year, as in Saxony, Sweden, and Denmark. It may also be grown in the richest pastures, provided the pastures be over-flocked, to keep the herbage bare. There cannot, however, be a doubt, that a dry light soil, particularly in the moist climate of England, is most favourable to the health of the sheep, and to the quality of the wool.

The experiments that have been made in England on the Merino sheep have not been so successful as in other countries, principally arising from two causes.

In the first place, the demand for meat in England will always make the wool but a secondary object for the grazier, and no crofs of the Merino sheep with the English has yet produced a race that equal in symmetry form the South Down sheep, or that will produce the same quantity of meat to the butcher in the same space of time, and with the same food. In the second place, the mode of washing the Merino and Anglo-Merino wool in England will, so long as it is practised, prevent the wool from obtaining its proper value in the market. From the great quantity of natural yolk or grease in the Merino fleece, it is impossible to wash the wool on the sheep’s back by mere immersion in water. In Spain no attempts are made to wash the wool upon the sheep’s back, but all the fleeces of a pile are regularly fortified, and the different sorts secured and dried before the wool is packed. But where the quantity of wool which any one grower possesses is small, as in England, it would not answer to send for wool-forters from a distance; and to wash the wool before it is forced, would so intermingle the fine with the coarse locks, as to render the regular sorting extremely difficult and expensive. In Saxony
Saxony and Sweden the wool is washed on the sheep's backs. The following account of the process is thus described by baron Schulz. The sheep are first washed with one part clear ley, and two parts lukewarm water, and then in another tub with leys in the water; after which the sheep are washed, laying them always on their backs, with their heads up, in a tub with clean water; and lastly, there is pored on the sheep, when standing on the ground, a sufficient quantity of water, which is as much as possible squeezed out of the wool. The sheep are afterwards driven into an unwatered meadow adjoining, and remain there, to prevent their soiling themselves in the sheep-houfe. They remain there a day and a night, or longer, till the wool be dry, which in fine weather will be in three days. Some performers wash their sheep twice, but the wool becomes harder in consequence of it, and has a greyer appearance.

The great quantity of grease which the finest Spanish wool contains at the first washing with the ley-water, and makes it quite foapy; but this grease is wanting in the second washing, so that the water is not in the least softened. Some mode of washing like the above must be introduced in England, before the manufacturer will encourage the Anglo-Merino wool; for after his purchase, when he thinks he has obtained sufficient allowance in the price to cover the waste, he is generally much disappointed in finding the losses in the manufacture so greatly to exceed his expectation, and he is deterred from making a second trial.

In the northern counties of England, and in Scotland, a practice has long prevailed of greasing the sheep with a mixture of tar and butter, to preserve the animal from the effects of moiture, and the inclemency of the weather in hilly and exposed situations. This practice seems at present peculiar to Britain, but the ancients evidently made use of mixtures of the dregs of olive wax, tar, wine, and other ingredients, to protect the skin of sheep after shearing, and to soften and improve the wool. Such was the practice of the Italian shepherds, as described by Virgil:

"Aut tonum trilli contingent corpus amurca,  
Et fummas miscent argenti vivaque suffula,  
Ideaflaque pices et pingues uingue ceras  
Scyllamque helleborofque graves nigrumque bitumen."  
Georg. lib. iii.

That this practice was extremely beneficial in warm climates, by protecting the skin of the sheep from incens after shearing, and by keeping the wool in a soft state, cannot be doubted.

The practice of greasing the sheep in Scotland, and the northern counties of England, with a mixture of tar and butter, seems to have been introduced merely to preserve the sheep, and was generally suppos'd to be injurious to the wool. Indeed the great proportion of tar, too frequently employed, gave some ground for entertaining this opinion; and the breed of sheep, on which this mixture was most generally applied, is naturally the worst which exists in Britain for the production of wool, the fleeces more nearly resembling coarse hair than wool; but Mr. Bakewell, in his Treatise on Wool, observes, that "in Northumberland, where the fine-wooled sheep have received the benefit of greasing with a mixture in which the proportion of tar was merely sufficient to give it due tenacity, the wool is greatly improved by the process, but the ignorance or selfishness of the wool-buyers for a long time prevented the acknowledgment of the fact." Many were afraid to purchase the wool on account of its dirty appearance, but its value is now better understood in the Yorkshire markets, and it is purchased by the manufacturers of coloured cloth in preference to the ungreased wool of the same degree of fineness. The same preference is also given to the cloths in the halls, where they are sold in an undressed state. When these cloths are finished, their superiority is more apparent, polishing a degree of softness far beyond the ungreased wool. These wools appear to improve in every process of the manufacture, and yield a cloth of greater value by twenty or thirty per cent. than the ungreased hard wools, though the latter may be equally fine.

But even in Northumberland, where the wool is so greatly improved by the practice, its good effects in this respect are not sufficiently known, and the operation is delayed till the approach of winter. By this delay, the upper part of the staple which is first grown, is deprived of the advantage of being kept in a moist soft state during the summer heat. When the operation has taken place, a perceptible improvement may be observed in the wool which is afterwards grown. The line of distinction is clearly marked by the skin, which the ungreased leaves in the staple, the bottom part of which, where it is applied, is finer and softer than the upper part which was grown before its application. This difference is so great, that a careful examination of the fine-greased wools of Northumberland might alone be sufficient to demonstrate the advantage of the practice, and the inconvenience of delaying the operation to the end of the year. To derive the most advantage from the ointment both to the wool and the sheepe, it should be applied immediately after shearing, and again at the approach of winter. By the first greasing, the wool will be kept soft and moist during the sultry heats of July and August, and the top of the staple would not become harsh and discoloured, which is frequently the case with English wool. One acknowledged advantage of greasing immediately after shearing should not be overlooked; it destroys the sheep-tick, and has a tendency to prevent cutaneous disempers, and to protect the skin from the bite of the fly. The manner of preparing the ointment in Northumberland is as follows:—From sixteen to twenty pounds of butter are placed over a gentle fire, and melted; a gallon of tar is then added, and the mixture stirred with a stick until the tar and butter are well combined, and form a soft tenacious ointment. Some skill is required in its application, the want of which has prevented the practice from prevailing more generally. If the ointment be rubbed on the wool, it collects on the top of the staple, where it detains the loosee foil, and becomes hard, and is injurious to the wool. The proper method is to divide the staples or locks with one hand, and apply the ointment with the finger immediately upon the skin; it is thus kept constantly soft by the warmth of the animal, and is equally diffused through the fleece. Attention to this circumstance is of the greatest importance to the success of the practice. The quantity laid on each animal varies in different districts. In the lighter mode of greasing, one gallon of tar and twenty pounds of butter will be sufficient for fifty sheep. In Scotland, where greasing is applied merely to preserve the animal against the inclemency of the climate, a much larger portion of tar is used: this would be very injurious to the wool, were it of any other than the very coarsest kind.

Could a cheap substitute for tar be found, which would possess equal tenacity, the ointment might be applied with great advantage to all our native breeds of English sheep, both for the preservation of the animal and the improvement of the wool. Mr. Bakewell states, that long combing-wools, which have been greased in this manner, produce a softer and superior yarn to any ever made from wool of the native English breeds which have not undergone the procefs.
On all chalk and light calcareous soils, the wool is always much harsher than wool of the same degree of finenes grown on argillaceous or siliceous soils; and this arises from the calcareous earth penetrating the fleece, and absorbing the natural grease, and thus rendering the fibres hard and elastic. These soils cover a large portion of the south-eastern counties of England, and of some of the midland counties; and it is well known to cloth manufacturers that the wool from these districts do not work so well, nor make so soft a cloth, as wool on siliceous or argillaceous soils. Nor will this wool felt in the fulling-mill like the softer wools. The practice of greasing would be of undoubted advantage in calcareous districts, applying the ointment more sparingly than in the northern counties.

Perhaps twenty-five pounds of butter, and one of tar, or two of bees' wax might be sufficient for one hundred South- Down sheep; and if the mixture were applied once after shearing, and again in October, the expense would be abundantly compensated by the improved condition both of the sheep and wool. The softness of wool appears to be essentially connected with the property of felting, and depends partly on the structure of the surface of the fibre, and partly on its possessing but a moderate degree of elasticity. The process of felting is best illustrated in the hat manufacture, where the fibres of wool or fur are brought into contact by pressure and warmth, and form a compact substance without the aid of spinning and weaving. In some parts of Tartary, coarse cloth for tents is manufactured by spreading the wool on the ground, and pressing it in warm water with the feet; this was probably the first mode of making cloth. All good woollen cloth is still woven comparatively loose, and is made firm and close in the fulling-mill. The fibres of wool or fur have a tendency to move more easily in one direction when pressed, than in the opposite direction. This motion has been compared to that of an ear of barley placed under the coat-sleeve, with the points of the beards downwards; by the action of the arm the ear is moved in a retrograde direction, until it has advanced from the wrilt to the shoulder. When we draw a hair of wool or fur through the fingers in a direction from the points to the root, we can feel a sensible degree of roughness, which is not felt if the hair be drawn from the root to the point. Hence we may suppose, that the surface is covered with a number of points or rings, which are too minute to be observed by the microscope, except in some kinds of fur, as in that from the South-sea seal, in which, with a powerful microscope, we have seen the surface covered with distinct leaves or points, shaped like those of the artichoke. We have a striking illustration of this tendency of the fibre to move in one direction in that particular process of hat-making, where it is intended to cover the felt or substance of the hat with fur of a superior kind. The felt on which this fur is to be laid being finished, the hair of the beaver is uniformly spread upon the surface, and being covered with a cloth, it is pressed and agitated by the hand for a certain time. The fibres of beaver-hair introduce themselves by their roots into the felt, and proceed to a certain depth, and become firmly fixed in it. If the pressure were continued for a longer time, the hairs would pass entirely through the felt, going out at the under surface, as each hair follows the direction it acquired at the beginning of the process.

As the felting property, therefore, seems to depend on the minute structure of the surface of the fibre, it is easy to conceive how this may be injured by a dry calcareous soil, and how this property is best preferred in those furs which are grown under a covering of coarse hair, and protected from external injury. The process of greasing is in some respects a substitute for such a covering, and not only defends the surface, but prevents the fibre from becoming dry, harsh, and elastic. The ancient Greeks and Romans were in the practice of covering their soft-wooled sheep, called mallea cover, with skins: this has been supposed to have been intended merely as a protection from briars and underwood; but we have no doubt that wool so covered would be much softer than wool exposed to the action of light, and of the soil. That the rays of the summer sun have a tendency to make wool both coarser and harsher, may be seen in the effect produced on sheep that are exposed to it without shelter immediately after shearing. The top point of the staple which was grown at that time is almost always coarser and harder than the bottom of the staple which has been grown under the cover of the upper part of the fleece, and consequently more protected from light. An analogous effect is produced on the skins of horses kept in coal-mines, which become fleek and soft. These facts may suggest to wool-growers deiforms of improving their wool, the advantage of providing shade for their flocks during the sultry heats of summer. The natural instincts of sheep might teach them the propriety, not to speak of the cruelty, of keeping their sheep in summer inclosed in pens, and unsheltered, upon a dry foil, where the animals are almost roasted alive; a practice not less injurious to the health of sheep than to all the other qualities of the wool. Next to a regular supply of food, protection from the effects of heat and wet are objects of the first importance in the management of sheep; and it may be stated as an undoubted truth, that whatever contributes to the comfort of the animal, will enable it to fatten with a smaller quantity of food, will tend to preserve it in a healthy state, and will also increase the quantity and improve the quality of the wool.

**WOOL.**  
**Chemical Examination of.** The chemical properties of wool are very similar to those of hair, and as we omitted to speak of these in their proper place, we shall introduce them here.

From the experiments of Achar and Hatchett, it appears that hair contains gelatine, to which it owes its suppleness and toughness. When hair is boiled in water, this principle is separated, and the hair becomes much more brittle than before. Indeed, if the processes be continued long enough, the hair crumbles to pieces between the fingers. The portion insoluble in water possesses, according to Mr. Hatchett, the properties of coagulated albumen.

Mr. Hatchett has concluded, from his experiments, that the hair which loses its curl in moist weather, and which is softest and most flexible, is that which yields its gelatine more readily; whereas strong and elastic hair yields it with the greatest difficulty, and in the smallest proportion. This conclusion has been confirmed by a very considerable hair merchant in London, who assured him that the first kind of hair was much more injured by boiling than the second.

Vauquelin has published a curious set of experiments on human hair of different colours. He found it completely soluble in a Papin's digester. During this process, sulphidretted hydrogen was evolved. The solution thus obtained contains a kind of bituminous oil, which is deposited very slowly. This oil was black when the hair was black, but yellowish-red when red hair was the subject of experiment. When this oil was removed, nut-galls and chloride produced copious precipitates. Silver was blackened, and acetate of lead precipitated brown. When concentrated by evaporation, it did not concrete into a jelly.
Water containing only four per cent. of potash dissolves hair, while hydro-sulphuret of ammonia is evolved. If the hair be black, a thick dark-coloured oil, with some sulphur and iron, remain undissolved. If the hair be red, this oil is yellowish. Acids throw down from this solution a precipitate, soluble in excess of acid.

Sulphuric and muriatic acids become red when first poured on hair, and gradually diffuse it. Nitric acid turns hair yellow, and diffuses it, while an oil separates, varying in colour, as before-mentioned, according to the colour of the hair employed. The solution contains a great deal of oxalic acid, besides bitter principle, iron, and sulphuric acid. Chlorine reduces it to a substance of the confidence of turpentine, partly soluble in alcohol.

Alcohol, digested on black hair, extracts from it two kinds of oil. The first, which is white, subdues in white shining scales as the liquor cools; the second is obtained by evaporating the alcohol. It has a greyish-green colour, and at last becomes solid. From red hair alcohol also extracts two oils, one white, as above, the other red as blood. After this latter has been extracted, the hair becomes chefnut. Hence its red colour appears to depend upon this oil.

Hair on incineration yields iron and manganese, sulphate and carbonate of lime, muriate of soda, and a considerable proportion of silica. The ashes of red hair contain less iron and manganese. Those of white hair still less; but in those we find magnesia, which is wanting in the ashes of other hair. The ashes of hair do not exceed one fifth of the hair.

Hence, according to this analysis, hair consists of:

1. Animal matters constituting the greatest part.
2. A white solid oil, small in quantity.
3. A greyish-green oil, more abundant.
4. Iron, rate unknown.
5. Oxid of manganese.
7. Carbonate of lime, very scanty.
8. Silica.

Vauquelin infers from these experiments, that hair depends for its colour upon a kind of oil, which varies according to the colour of the hair in which it is found. He also supposes, that sulphuret of iron contributes to the colour of black hair. The sudden change of colour in hair from grief, he thinks, is owing to the evolution of an acid. Bichat, however, attributes this change, perhaps with greater probability, to the absorption of the colouring principle. To whatever cause it be owing, the fact appears undoubted; and it shews a closer connexion between the living powers and the hair, than many physiologists are inclined to admit.

Wool appears, according to the experiments of Berthollet, to coincide almost exactly in its chemical properties with those of hair above-mentioned. When growing on the back of the animal, it is enveloped in a greyish matter, called the gold, and which appears to be a kind of soap; or, more properly speaking, according to the experiments of Vauquelin, who has examined it, of

1. A soap of potash.
2. Carbonate of potash.
3. A little acetate of potash.
4. Lime.
5. A little muriate of potash.
6. An animal matter.

This substance appears to have the property of protecting the animal from insects to a certain degree, and of preferring the softness of the wool, which are perhaps its chief uses. It is removed from the wool before it is manufactured, by the process termed scouring. The affinity of the animal matter of wool for all colouring principles is very great, and in general far exceeds that of the different vegetable fibres, as cotton, flax, &c. for such principles. There is one kind of coarse wool, however, which, according to Dr. Bancroft, does not possess this property, and receives colours with great difficulty. See Dyeing, and the preceding article.

Wool, Laws relating to. The jealousy entertained on the subject of our wool, may be learnt from the legal restrictions which have been made in relation thereto; as also with the view that as much employment as is possible may be found for the labouring classes. This is effected by the prohibition of the exportation of wool in an unmanufactured state, as will be seen below. It must be obvious, however, that it would be to little purpose to be thus strict respecting the article itself, if that which produced it was not equally guarded; therefore as early as 13 & 14 Ch. II. c. 18. it was made felony to export sheep from England or Ireland, or even to Scotland: now however the penalty is forfeiture of every ram, sheep, or lamb, and the vessel in which such is shipped with intent to exportation from Great Britain and the islands belonging thereto; and offenders are to forfeit $5. for every sheep, &c. so shipped, and to suffer three months solitary imprisonment, and till the forfeiture be paid, but not to exceed twelve months; and for any second offence $5. for each ram, &c. and six months imprisonment, and till the fine is paid, but not to exceed two years. 28 Geo. III. c. 38. § 2.

By the 9th and 37th sections, no wool, woolfells, mornings, yarn, or worsted made of wool, woollocks, coverings, cruels, waddings, or other manufactures, or pretended manufactures slightly wrought up so that it may be reduced to wool again, or mattrelles, or beds stuffed with wool combed or fit for combing or carding, may be shipped or exported, or carried or moved for that purpose, from Great Britain, or Guernsey, Jersey, Alderney, Sark, or Man, to any foreign place, on forfeiture of the wool, with the carriage, ship, or cattle on which it is laden or removed; but 300 sheep may be sent annually from Liverpool or Whitehaven to the Isle of Man (51 Geo. III. c. 50.); and the person offending to forfeit $5. for every pound weight, or $50. in the whole, and to be imprisoned three months, and till the penalty is paid, but not to exceed six months; but for a second offence he is to forfeit the like sums, and to be imprisoned for fix months, and till such fine be paid, not exceeding two years; but this is not to extend to lambkins drefsed for furs and linings.

And persons qualified by the governors of the following islands may export the respective qualities set against them from Southampton to those places in every year:

<table>
<thead>
<tr>
<th>Country</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>To Jersey</td>
<td>4000</td>
</tr>
<tr>
<td>To Guernsey</td>
<td>2000</td>
</tr>
<tr>
<td>To Alderney</td>
<td>400</td>
</tr>
<tr>
<td>To Sark</td>
<td>200</td>
</tr>
</tbody>
</table>

28 Geo. III. c. 38. §§ 16, 17. And 20,000 pounds weight of worsted and woollen yarn may be exported annually from London to Lower Canada, by permission of his majesty in council. 47 Geo III. c. 9. 52 Geo. III. c. 55.

By the 48 Geo. III. c. 44. wool may be shipped in England for exportation to Ireland, on being duly entered and bonded given for its true exportation there; and upon obtaining a licence under the hands of the commissioners of the customs to allow it. No
No wool shipped to be sent coallwife from one part of Great Britain to another, until due notice be given and bond entered into, and a licence obtained under the hand of three commissioners of the customs. Penalty, forfeiture. 28 Geo. III. c. 38. § 34. And wool must also be shipped coallwise in British ship, British owned and manned, the owner of which does not reside out of Great Britain. § 19. and 12 Car. II. c. 18. Formerly there were penalties and forfeitures for keeping or removing wool in Kent and Suff- fex within certain distances of the sea (ten and fifteen miles), without entry and bond, and procuring certificates or permits, and also for removing wool within five miles of the sea-coast of Great Britain before sun-rising and after sun-set; but by the 54 Geo. III. c. 78. all the regulations formerly required antecedent to the removal of wool on land throughout England are repealed.

Wool to be packed in packs, or trusses of leather, or canvas, called 'Pack-cloths,' or in linen or woollen, and to be marked 'Wool,' in letters three inches long, on forfeit of the wool, and 1s. per pound. 28 Geo. III. c. 38. § 28.

Perfons packing wool, &c. into boxes, barrels, casks, or chests, and other than as above, or prefling or fleaving the same, to forfeit the goods, and 3s. per pound. Ibid. § 30, 31.

Insurances for the conveyance of wool contrary to this act void, and the parties may be punished. § 45, 46, 47, 48.

King's ships empowered and required to search ships for wool shipped without licence. § 49, 50, 51.

No perfon can feize wool unlawfully removing but officers of customs, excife, and falt-duties, or perfons accompanied by a constable (§ 52.); and perfons neglecting their duty to forfeit 20l., and making collusive forfeits or agreements to be fubjeft to like penalties as exporters. (§ 53-55.) Hindering, obftruding, or beating officers, fubjefts offenders to transportation; and bribery of them, whether accepted or not, to the penalty of 300l. § 56, 57.

If any question arises upon the growth of the wool, the onus probandi is to lie upon the owners. § 60.

Information may be laid in any court of record, and penalties, &c. under 200l. may be determined before two juftices of the peace; and juftices at quarter-feffions may direct ships, goods, wool, &c. to be fold. § 62, 63.

Proceflions to be commenced within three years.

§ 77: Wool the growth of Ireland may be exported to England, and no where else. 1 W. & M. c. 32. 7 & 8 W. III. c. 28. 10 & 11 W. III. c. 10. 26 Geo. III. c. 11.

And the Admiralty is to appoint three ships of the fifth rate, and eight or more armed floops, to prevent the exportation of wool from Ireland to foreign ports. 5 Geo. II. c. 21.

Wool the produce of any of the colonies, &c. in America, or countries on the continent of America, subject to any foreign European nations, imported into certain British West India iflands, may be imported into Great Britain under the regulations of the 12 Car. II. c. 18.

Thofe places are, Jamaica, Granada, Dominica, Antigua, Trinidad, Tobago, New Providence, Crooked ifland, St. Vincent, Bermuda, Caios, Tortola, Curacoa, and the Bahamas. 27 Geo. III. c. 27. 45 Geo. III. c. 57-47 Geo. III. feff. 2. c. 34.

British hare or coey wool may not be exported, (except to Ireland, 50 & 40 Geo. III. c. 67.) on penalty of forfeiture. The owner or shipper to pay 100l., and the master of the ship 40l. 24 Geo. III. c. 21.

Wool. Cheife made under, in Rural Economy, a term applied to that fort of high-tailed ewe cheehe which is made before the sheep are thorn. See Cheese.

Wool, Pack of, a quantity of wool packed up closely together in a large bag of the pack-cloth kind, which in London is constituted of two hundred and forty pounds. See Wool.

Wool, Packet of. See Packet.

Wool, Saplar of. See Saplar.

Wool-Stapler, a perfon who staples and deals in wool. See Wool.

Wool-Stapling. See Stapling of Wool.

Wool-Balls, in Natural History, maflles of wool compacted into firma and hard balls, and found in the flemachs of sheep, as the hair-balls are in oxen and other animals.

These are doubtlefs formed in the fame manner as thofe hair-balls of the outer covering of the animal; but they are much more uncommon; they are found in numbers, three, four, or five, in the flemach of the fame animal. Their outide has commonly much the fame appearance of a puff-ball, and is ufually either in part or wholly covered with a very thin and foft blackfiah smooth skin; the inner fubftance is entirely wool, but that wrought together as clofly as the hatter does his furs in the making of them into hats.

They are ufually loft, smooth, and somewhat elaftic, of a pale buff-colour, very flight, and of irregular figures rather cubic than globular, and feldom of any great fize, an inch in diameter being their common fandard. More- ton's Northampton, p. 451. See Balls.

WOOLASSEY, in Geography, a town of Bengal; 42 miles N.E. of Calcutta.

WOOLDALE, a township of England, in the Weft Riding of Yorkshire, near Wakefield.

WOOLDAW, a town of Bengal; 40 miles W. of Nagore.

WOOLDER, Single and Double-Handed, in Ship-Building, are fticks about three feet long, and four inches in circumference, with flaps of rope-yarn made falt, to fix on the rope in making, and affift the men at the hooks in closing the rope.

WOOLING, is winding several clofe turns of rope in a tight manner round the mafls and yards, that are made of feveral united pieces, to ftrengthen and confine the fame together. In making new mafls and yards, this method is discontinued, and iron hoops ufed in lieu.

WOOLING is also the rope employed in this service.

WOOL-DRIVERS, are thofe who buy wool of the sheep-owners in the country, and carry it on horfback to the clothiers, or market-towns, to fell it again.

WOOLER, anciently Willove, in Geography, a market-town, and parish in the ward of Coquet-dale, and county of Northumberland, England. The former is situated near the Chevill-Jills, 17 miles S. from Berwick-upon-Tweed, 46 N. by W. from Newcastle, and 350 in the fame direction from London. In 1811 the houses in the parish were 284, inhabited by 1704 perfons. A market is held on Thursday, and fairs on the 4th of May and 17th of October. Wooler was a barony, and confifled of several manors in the time of Henry I., who conferred it on Robert de Mulup, whose fuccedor Robert, in the reign of Henry III., was the moft powerful baron in the north of England; it now belongs to the earl of Tankerville. The church was re- built in 1765, and the town contains fome meeting-houses for diftenders. Situated near the confines between the king-
WOOLLEN MANUFACTURE.

The origin of the woolen manufacture, like that of many other useful arts, is not precisely known. At a very early period, domestic sheep were extensively spread over Western Asia. The introduction of sheep into Europe is not recorded by ancient writers, unless we suppose the expedition of the Argonauts to Colchis to refer to this event. Sheep were probably first domesticated for their milk, and afterwards for their skins, which must have been the first drefs of pastoral nations. Sheep and goats, in the early ages of society, were nearly of equal value. The Greeks, who ostentatiously refer all useful discoveries to their own country, and rank their inventors among the gods, have ascribed to Minerva the invention of spinning and weaving. These arts appear, however, to have been first practised, at a very early period, in Egypt, and applied to the spinning and weaving of flax. At what time they were first applied to wool is unknown. Though Pliny informs us, that Nicias of Megara discovered the art of fulling cloth, the property which wool possesses of felting was known in the East at a much earlier period, and probably gave rise to the first manufacture of woolen goods which were not woven, but felted like the substance of hats.

On this subject, Mr. Luccock, in his Treatise on Wool, judiciously remarks, "whilst the skins of sheep dressed with their wool on served as clothing, it is obvious that only one useful fleece could be obtained from one animal, and as the fleece is generally cast, or falls off once a year, this produce must have been waited. In a very early period, however, the property which wool possesses of felting was discovered, or, in other words, it was found that by pressing and moistening the fibres of wool might be made to adhere together, and produce a compact pliable substance, quite as durable and more convenient than the skins formerly used. This appears to have been the first effort to produce a woolen manufacture." It is probable the felting property was discovered by accident, as some fleeces will felt upon the sheep's backs; among farmers, there are called cotted fleeces. When the application of this discovery was first made, the knowledge of the art was soon widely spread. The tents of the Arabs and Tartars are, at the present day, all made of felt from the wool of sheep, mingled with the hair of goats, camels, and other quadrupeds, and may be considered as remains of the original art of cloth-making.

The art of spinning and weaving threads made from wool was, in all probability, derived from the East; they are alluded to by Moles as existing nearly fifteen hundred years before the Christian era, and it appears that the early patriarchs had numerous flocks of sheep.

The greater part of these sheep, we are informed, were, at first, either dark-coloured or spotted; hence we may infer that the art of dyeing wool was then unknown. When the selection and cultivation of white wool gave to woolen cloth the property of receiving the tints of the dye, the value and use of wool must have greatly increased, owing to the great estimation in which richly-coloured garments are held by people advancing to a state of civilization.

Thus, in addition to the superior pliability and comfort of woolen cloth, compared with skins or felts, the taste for it must have been widely spread by the art of dyeing. It had also the great recommendation to its general adoption, that it could be manufactured with ease in every family. The machinery required for the purpose was extremely simple. The distaff and the loom, says Mr. Luccock, were little more in the hands of the first manufacturers, than the spade in those of the husbandman. Spinning and weaving, as we have already observed, were in use at least fifteen hundred years before the Christian era; but the manner in which they were performed is not related until about three centuries afterwards. Then the loom consisted of a frame of wood, in some respect different from the modern one, but well adapted to the same purposes.

The alterations which have been made in it consist, perhaps, more in the position of the beam, and the mode of opening the web for the passage of the shuttle, than in any other circumstance. Nor was the earliest mode of spinning left perfect, than that which was practised in the most celebrated manufacturing countries for many ages afterwards. It was performed by means of a rod or staff, about which the wool to be spun was carefully wound, and held in the left-hand, while a rough kind of spindle, quickly twirled between the right-hand and the thigh, was suffered to continue its motion when suspended by the thread which the artificer gradually lengthened with his fingers. This least complex of spinning-machines is not entirely laid aside even now. A few years since it was not uncommon in the county of Norfolk, and its continuance in use through so many ages is the best proof of its excellence.

The preparing of wool for spinning was probably first effected by the fingers, and afterwards by the fuller's teazle or thistle, the diplocus fallorum, which with its rough and hooked points was well adapted to the purpose, and has continued in use to the present day. The card afterwards used was probably a substitute for the cardums, or teazle. The application of the wheel to a spindle, or the spinning-wheel, as we believe, unnoticed in history. Whenever these inventions took place, it is probable their first introduction contributed more to increase the quantity, than improve the quality of the yarn and cloth. For a considerable period after the commencement of the woolen manufacture, the improvements made in spinning or weaving of wool were effected by the improved address and skill of the manufacturer, rather than by any alteration in his machinery, as we now see the manufacturing nations of the East execute very elaborate works with instruments of the most simple construction. In proportion as luxury and refinement increased, the demand for superior fabrics would induce the growers of wool to pay great attention to the fleece, and to select and preserve for breeding those sheep which produced the finest and finest wool; with the ancients these terms were synonymous. The produce of fine white wool from sheep is entirely the result of cultivation; it has never been grown except in countries where the woolen manufactures have flourished. The race of fine-wooled sheep has, however, been partly preferred in those countries after the diminution of their trade. The grower would also soon learn to pay particular attention to the whitefels of his fheep, as a clear white ground is necessary for receiving the most brilliant dyes. Blue, purple, and scarlet, were the tints most admired; and though the ingredients, by means of which they were produced, are in some measure unknown, yet we have the most indubitable testimonies to their excellency, and the estimation in which they were held. To produce them in their richest lustre,
woollen manufacture.

fulre, a selection of the wool most adapted to receive them must be made, and this would operate with great precision upon the wool-foster’s attention.

While the manufacture of wool was confined to the housetops of the grower, and the business of it transacted by his domestics in a secluded fashion, there was left room for the stimulation and exercise of invention than in after-ages, when it became the appropriate calling of one particular part of the community, and their success depended upon the opinion which others formed of the fabric. "Yet in the simplest days of Greece, it was not deemed an employment unfitting to palaces, nor did a prince degrade her dignity by superintending the labours of the loom, the dithaff, and the dyeing vat.

We have little information respecting the woollen manufactures of the Greeks and Romans, as distinct from their domestic manufactures; but large establishments were necessary for the clothing of distant armies, and for foreign commerce. That the Romans had carried the manufacture of fine woollen cloth to a high degree of perfection, is proved by a variety of circumstances, and particularly by the great attention paid to the cultivation of fine-wooled sheep, and by the high prices at which the wool and sheep were sold, as appears from the writings of Pliny, Varro, and Columella. Pliny describes two kinds of sheep: the one which gave coarse long wool, and was on this account called birsim or hirsutum, and from its hardines and ruder treatment coluntum or rutilus; the other breed was called mallus, from the softness of the wool, and genorum or noble, from its excellence; also pallium, from its being clothed with licks to protect the wool. The race is sometimes also called Tarentinum, Apulum, Calabrum Atticam, and Orcenum, from the neighbourhood or district in which it chiefly lived; but what is of more importance, as shewing the origin of the fine-wooled sheep of Italy, the race is called Afianum; and, according to Pliny, a similar race existed in his time at Laodicea in Syria. The description given of these sheep by Pliny agrees with the present race of Merino sheep. There is not a saying Dr. Parry, throughout Europe, any breed of short-wooled sheep now existing besides the Merino, of which the males are horned and the females not.

That the Romans imported their Tarentine sheep into their western colonies, with the art of manufacturing fine cloth, we learn from Strabo and Pliny. The former writer, who flourished in the reign of Augustus, says, that in Tarentania in Portugal, then a part of Spain, "they formerly imported many garments, but now their wool was better than that of the Coraxi, and so beautiful, that a ram for the purpose of breeding was sold for a talent, and that fabrics of extraordinary thinness were made of this wool by the Salutari." Probably this was similar to the Shaw cloth of Ireland, and woven in the same manner, as Pliny calls it scutulum, a term which he applies also to the spider’s-web. The little attick of silver is estimated to equal in value 216L. of English money, which shews the high estimation in which the best wool was held even in the colonies of Rome.

All ranks of people of both sexes among the Romans chiefly wore woollen garments. In the reign of Aurelian, 270 years after Christ, a pound of silk, according to Vopifcus, was equal to a pound of gold. A people fo eminent in wealth, and in all the refinements of art, would naturally be solicitous to attain the highest degree of excellence in the manufacture of their fabrics, which were calculated to gratify their passion for adorning their persons, and it was equally as necessary to consult their taste as their vanity. The summer-heat of Italy was so great, that the affluent could scarcely have supported a woollen dres, as it had not been made of the lightest and thinnest cloth. We find also, that during the Augustan age, and for a considerable time afterwards, it was the fashion to wear cloths which, as at present, were furnished with a raised nap or pile. Such cloths were called pexis, in contradistinction to trite or thread-bare. Thus Horace:

"Si forte subsecua pexis
Trite sib elt tunica — rides."

"You laugh if you enjoy a thread-bare veil
Under a well-dressed tunic."

And also Martial:

"Pexatus pulchre, rides mea, Zoile trita."

The term pexatus, applied to cloth, leads us to suppose that the nap or pile was raised with a comb, having very fine teeth. Pliny informs us, that in his time the price of wool had never exceeded 100 sesterces the libra, or pound; now the Roman sesterces being about $6. of our money, and the libra about 5245 grains, it follows that an avoidopus pound, or 7008 grains, would have cost about 1/2, 2s. of our money. From the intercourse with Persia and the East, the Romans would become acquainted with the Shaw cloths of India, and would naturally wish to imitate so beautiful and delicate a fabric. These are made from very soft fine short wool, and not from combed wool, as has been generally supposed in this country. The existence of that manufacture in Hindoostan for many ages, is a proof of the high degree of perfection to which the manufacture of woollen cloth had been carried in former times. For shawl-cloth is only woollen cloth, woven with a twist, and unmilled, but it is spun to a great degree of fineness, and from wool so peculiarly soft, that it has never been rivalled by any European nations. The perfection of the colours, and the skill displayed in the weaving, we have no reason to believe are greater now than in the time of Alexander the Great; and if these manufactures were successfully imitated by the Greeks or Romans, or even diligently approached in the manufacture of their fine cloths, we may form some idea of the perfection to which they had arrived. When in the decline of the Roman empire, their colonies were overrun by savage barbarians, all their public establishments and manufactures were destroyed, but the art of producing from the fleece a warm andsubstantial clothing was never entirely lost, even during the darkest days of ignorance. It began to revive, and became the separate occupation of one class of the community about the middle of the tenth century in the Low Countries, where it remained the glory of the people, and the source of their opulence, through more than four hundred years. The wool which it consumed for the first few years was the produce of their own pastures, which had but lately been reclaimed from the forest; but as the manufacture extended itself, the demands became larger, and were supplied from a greater distance. The wealth which it distributed was soon visible, and people crowded into the country, engaged in its commerce, and pushed their speculations with increasing vigour through a hundred and fifty years, when an inundation of the sea threatened to involve the art, the artift, and the country, in one general destruction. The dispersion of the people who fled from the calamity which appeared to overwhelm their hopes, instead of destroying the infant manufacture, gave it additional vigour, and was the means of effecting a connection between
WOOLLEN MANUFACTURE.

between the Netherlands and foreign countries, which proved of the highest importance to commerce. It contributed to a much more speedy recovery of the arts connected with the woolen manufacture, from the ruin which seemed to threaten them, and gave a striking instance of their partiality for the fleeces where they have once flourished, under the patronage of a government liberal enough to encourage, and sufficiently powerful to protect them, even in situations attended with natural disadvantages. The influence of these manufactures upon the fleeces of the Low Countries must have been very considerable; for before the year 965 we have no reason to suppose that their quality was superior to that which we find in the neighbouring districts; yet it was not very long ere Flanders and Brabant became famous for the manufacture of fine cloths, even at a period when they imported but little foreign wool. Perhaps the fabrics might not be equal to those which we now produce from the fleeces of Spain, or even from the improved ones of our own sheep, but they were preferable to those of England and the nations of the continent, Italy and Spain excepted. It was about the year 1200 that the merchants began to import the wools of other countries, to extend their connections much more widely, and to grow by this means still more rich and powerful. The manufacturers required a larger quantity of the raw material than usual, and the population of the country had reached that extent which does not admit of a great number of sheep being kept, even though the employment of the people depend upon the fleeces, and their subsistence upon the food which they furnish. We shall observe instances of a similar kind when we treat more particularly of Spain. The operation of these two causes was evidently insufficient to induce the manufacturer to go farther from home, and to seek the most convenient methods of supplying his looms. It might have been expected that he would have turned his attention to France and to Germany; but independent of the hostile dispositions of some of the neighbouring sovereigns, the raw material was too bulky to be conveyed at an easy expense through the bad roads of a half cultivated country; and the ships of Spain and of Great Britain, who found an interest in supplying the wants of the Netherlands, unloaded their cargoes almost at his very door, and solicited in payment but little else than the goods which he had manufactured.

Spain was the first country on the western side of Europe, where the Tarentine breed of fine-wooled sheep were cultivated with success by the Romans. See Sheep. This breed, intermixed with the native flocks, gave rise to the present fine-wooled sheeps of Spain; and it does not appear that this valuable race was ever greatly neglected in that country. That it abounded in sheep in what is called the middle age cannot be doubted. At the period when the Saracens extended themselves in Spain, about the eighth century, to use the quaint words of Roderick, archbishop of Toledo, "it was fruitful in corn, pleasant in fruits, delicious in fishes, favoury in milk, clamorous in hunting, and glutinous in herds and flocks,"—Salutis arma et 

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Christian neighbours, Spain saw nothing but the change of religion to compensate the loss of population, of agricultural and mechanical science, of industry, and wealth. On the recovery of the Seville from the Moors in 1248, not less than 16,000 looms are said to have been found in that city. Of these, the greater number was probably employed in the fabric of woolen cloths. According to Ulfar, "The Theory and Practice of Commerce," the manufactures of Segovia flourished most, both in point of number and quality; and were in high esteem, being the best and finest that were known in ancient times. The temperature of the climate, and the luxurious propensities of the inhabitants, would naturally determine these fabrics to be of the lightest and finest kinds. Hence in the midst of the boasted ancient manufactures of England, we read only of two or three instances of the importation of English cloth into Spain. The Spaniards had certainly at that time their own native fleeces best adapted to their own taste and climate.

We are told by Dillon, in his "History of Peter the Cruel," that the woolen cloths of Barcelona were in high esteem in Seville in the reign of that prince, and in the preceding century. So far back as 1245, the woolen cloth of Lerida is spoken of in terms of great estimation. A few years after, Barulas, Valis, Gerena, Perpignan, and Tortosa, were remarkable as manufacturing towns, and for the fineness of their cloths, flufians, and serges. So great was their exportation, that in 1353 there were 935 bales of cloth taken on board a ship from Barcelona to Alexandria by a Genoese privatee; and 1000 bales of cloth were taken on board three Catalanian ships in 1412, by Antonio Dorco, in the port of Callis. We are told by the same author, that, according to records still extant in Barcelona, considerable orders for wool were sent to England in 1416, in order to be manufactured there and returned to England in the form of cloth, the Spaniards themselves disdaining to wear it.

According to Lucius Marineus Siculus, who wrote in the time of the emperor Charles V., Spain was then full of herds and flocks, more especially it contained innumerable sheep; so that many shepherds, whom he knew, had flocks of 30,000 each; on which account Spain not only supplied its own people most abundantly, but also foreign nations, with the very finest wool.

This account is confirmed by what is related by Sandoval, who states, that in an insurrection in Spain in 1519, the army of insurgents, among whom were many cloth-workers, fitted up, among other points, that the cloths imported into Spain should be of the same fine and goodness as those which were supplied to them; and that the merchants and clothiers might have leave to seize, in order to work up, half the woollf for exportation, paying the owners the price at which they had been bought. Hence we learn the superiority of Spanish cloth, and the great sale of Spanish wool to foreign countries at that time.

Damianus a Goes, who was page to Emanuel, king of Portugal, in 1516, has written a short account of the memorable things of Spain, which he dates at Louvain in the year 1541. In this work he says, that there are annually exported from Spain to Bruges 40,000 sacks of wool, each selling at the lowest for twenty gold ducats.

Now from an authentic acquaintance, preferred in the Fædera, from queen Elizabeth to Cofmo de Medici, for a sum borrowed by him of Henry VIII., we find that the gold ducat or florin was in 1545 equal to five shillings of our money. In this year, the 36th of Henry VIII., the base coinages began; but as queen Elizabeth seems to have continued receiving the infeimals of the Florentine debt...
for several years at the same rate, when the shilling was of something more than the present value, we think it probable that the rate was fixed at the beginning of the year 1545, when the shilling was at 1s. 12d. of our present coin. This wool was, therefore, worth at least 3l. 14s. 7d. the sack of 18½ lbs., and 11l. 9s. 2d. the sack of 364 lbs.

In 1560, in the time of Guicciardini, Spanish wool in the Netherlands was at a somewhat lower price. He tells us, "that they used formerly to lend annually from Spain to Bruges more than 40,000 sacks, but that in this year the Spaniards, having more cloth at home, had lent only 25,000 sacks, at 25 crowns each." The crown being 4s. and the shilling 1s. 9d. of our money, this would be 10l. 1s. 2d. the sack of 364 pounds. The depreciation seems in truth to have arisen from a diminished demand for this wool in the Netherlands. The woollen imported into the Netherlands from Spain were the lower or coarser kinds.

The superfine wools of Spain seem to have been first introduced among the Italian states. Thus Damianus a Goes in 1541, after having specified the 40,000 sacks to Bruges, as before-mentioned, adds, "and also to Italy, and other cities of the Netherlands, are annually sent about 20,000 sacks, of which those used in Italy, being of the choiceest wool, are sold at from forty to fifty gold ducats each."

From this account, we have a fair opportunity of drawing two important inferences: the first is, that the Spanish wool which went to the Netherlands was, as we have before observed, of the coarsest kind, being of only half the price of that which was exported to Italy; secondly, we can compare the value of the latter with that of our English wool, the belt of which, according to the act of parliament in 1534, already quoted, did not in England exceed 5s. the stone of 14 pounds, of 3l. 12s. the sack of 364 pounds. The shilling, however, being then equal to 1s. 4½d. of our coin, increases the price of the sack 8l. 18s. 9d.; to which add custom and subsidy, 3l. 13s. 4d. or 5s. 10½d., and the result will be 13l. 19s. 7d. The additional charges of freight and merchant's profit would fearfully bring the whole amount to 16l. 16s. On the other hand, according to the testimony of Damianus a Goes, the Spanish sack of 18½ pounds was in 1541 worth 14l. 6s. 5½d., and the sack of 364 pounds 28l. 14s. 6d. of our present money. If the author speaks only of the value of this wool in Spain itself, then a farther addition must be made of freight, merchant's profit, and probable duty to the crown. On the whole, this calculation is sufficient to shew in the strongest light the superior price of superfine Spanish wool, to that of the very best at that time produced in Britain.

Next in order of time to the Italians, the manufacture of superfine wool seems to have been adopted by the French, who, according to Guicciardini, in 1560 lent by land to Antwerp some very fine cloths of Paris and Rouen, which were highly prized.

It is probable, however, that these cloths were made only of mixed wool.

A strong confirmation of the early use of the best Spanish wool, unmixed with coarser by the Italian states, is furnished by Richelieu's Political Testament, printed in 1635, in which, speaking of the fine woollen manufactures of France, the author says, "the Turks prefer the draps de fceau de Rouen to all others, next to those of Venice, which are made of Spanish wool."

And the author of "England's Safety in Trade's Increase," written in 1641, tells us, that "the greatest part of their (the Venetians) wools from Spain, and the rest from Constantiople, is commonly brought in English shipping."

In 1646, Nicholas Cadeau and other Frenchmen had letters patent for twenty years, for making at Sedan black and coloured cloths, like those of Holland, of the finest Spanish wool.

The inhabitants of the north of Europe, as before-mentioned, were not at first able to manufacture fine Spanish wool, without the assistance of that which was longer and coarser. But what in the beginning was a matter of necessity, became afterwards an object of choice; and the more skillful clothiers, whether in Holland or elsewhere, either carding the finer and dearer Spanish with the coarser and cheaper English, or forming a warp of the latter, which they covered with a woof of the former, contrived to make a cheap and serviceable cloth, which pleased the eye equally well with the more costly fabrics of entire Spanish wool. This though generally concealed with great care at the time, yet is afterwards candidly acknowledged by writers actually engaged in the commerce of wool, and sufficiently refutes the prejudices which had here prevailed from the middle of the 16th to the middle of the 17th century. Hence it appears that our wool, when placed in connection with Spanish, was chiefly valuable from being well calculated not to improve but to adulterate it.

A treaty between France and Spain in 1659, enabled the former freely to obtain the wool of the latter, and thus to gain great advantage over us in the Levant trade. From the proximity of France to the woollen manufactories in the north of Spain, it might have been expected that the French would have earlier engaged in this manufacture; but owing to their frequent northern wars, and their attention being directed to the manufacture of silk, the French do not appear to have commenced the fabrication of woollens for exportation extensively before the 16th century. About this time, France made great progress in her manufactures of wool, and in securing the export trade, particularly that to Tartary, for which she was better situated than Holland or England.

The nature of her trade to warm climates directed her attention to the fabrication of finer and lighter cloths, than those made by her northern neighbours; in consequence of which she preferred the greater part of the Turkey trade to the period of the French revolution, and in general fine French cloths had attained a celebrity for their superiority, both in texture and dye, over those of any other country in Europe. The native breeds of sheep in France were greatly improved by intermixture with sheep imported from Spain. With these advantages, France might have nearly secured a monopoly of the finer branches of the woollen manufacture, had not the abridgment of her rulers, in the revocation of the edict of Nantes, driven the manufacturing Protestants to other countries, where they contributed, by their exertion, their skill, connections, and capital, to form establishments which rivalled those of the country from which they were expelled.

Notwithstanding this, as France supplied the greater part of her own population of twenty millions with cloth, besides her foreign exports, we conceive that the woolens manufactured in that country, before the late revolution, equalled in quality the cloth made in England at the time, and greatly exceeded it in value. Under the emperor Napoleon, the best Merino flocks were imported in multitudes from Spain, which have spread over the country, and are equal to supply extensively her manufactures of woollens, when they shall be again fully established. Considerable quantities of fine wool have been imported from France into England since the peace of 1815.
WOOLLEN MANUFACTURE.

The confusion attendant on a great revolution, continued for twenty years, gave to severe a blow to the manufacturing establishments of France, that a considerable time must elapse before they are completely established. Prior to this revolution, the superfine cloths of France were superior to those of England, in texture, colours, and softness. In the finer articles of worsted goods, and in the mixed worsted goods made partly with long combing-wool, and partly with silk or goat’s-wool from the Levant, they surpassed the manufactures of this country; but the manufacturers of the commoner kinds of worsted goods, as tammys and failloons, could not rival us in foreign markets for want of a proper supply of wool suited to the purpose. The following were the principal feats of the superfine and fine woolen manufactures in France, arranged according to the different qualities of the goods made at each, beginning with the finest:

1. The manufactures of Gobelin's.
2. Of Sedan.
3. Of Abbeville.
4. Of Louviers.
5. Of Elbœuf.
6. Of Rouen and Darnetal.

Besides several detached manufacturing establishments of superfine cloth in Languedoc, Champagne, and other parts of France.

At the Gobelin’s, superfine cloths of the very finest quality were manufactured; but the manufactures there were confined solely to the broadest white cloth intended to be dyed scarlet or purple, and the brightest colours from cochineal.

Sedan followed next to Gobelin’s for the beauty of its superfine cloths, where they were also made of various breadths and colours.

Abbeville may be placed next after Sedan; some have even supposed that it equalled Sedan in the fineness of its cloths; but this arose from the cloths of the latter place being of various sorts; the lower kinds were certainly inferior to those of Abbeville; but the quality of the greater part of the cloths of Sedan were of a better kind than the average quality of the cloths of Abbeville. In the manufactures of Sedan, each manufacturer confined himself to a particular kind of cloth, for which he became distinguished, some being celebrated for fine, and others for superfine cloths exclusively; whereas in Abbeville, Louviers, and the other districts enumerated, there were manufacturers who made various sorts, and the proportion of the fine to the superfine was greater than at Sedan.

Elbœuf was one of the most ancient seats of the woolen manufacturies in France, but the quality of the cloths made there had greatly degenerated from the years 1760 to 1770; but afterwards the manufacturers returned to the former quality of their cloths, which were partly made of the fine wools from Beffy, and partly from fine Spanish wooll, or from a mixture of Spanish with the wool wools of Berry.

Rouen and Darnetal may be placed in the fifth class of manufacturing districts of fine cloth, in which the finest wools of France were principally used, mixed with those of Spain.

The establishments for the manufacture of common cloth and coarse woollens were much more widely spread over France. The goods appear to have been principally consumed in that country to supply the demand of a population of twenty millions, and the numerous military establishments, besides what might be sent to the French colonies.

As the French never exported any considerable quantity of common or coarse woolen cloths, the manufactories of these articles never equalled in extent those of England. The circumstance of the coarse cloth manufacture being to widely spread over the country, tended also to prevent that degree of rivalry which promotes the spirit of improvement where manufactures are more concentrated; and to this, the French had not that abundant supply of the coarser clothing-wools which could enable them to rival us in the export of heavy woolen goods.

The worsted manufacturies of France, including serges and those goods made with a warp of worsted, were principally carried on in four of the provinces of France, but more extensively in Picardy than elsewhere. The long combing-wools which supplied this manufacture, were partly the produce of France, and partly imported from Holland, England, Flanders, and Germany. M. Rolland, in the French Encyclopaedia, describing the French manufacturies in the year 1783, soon after the American war, says, that during that war the English administration tacitly encouraged the exportation of wool to promote the interests of agriculture. He describes the French combing-wool as being coarser and more harth than the wool of Holland, as waiting much more in the manufacture, and making goods of a very inferior quality. The combing-wools of England, though generally less found and fine, and of a less pure white, than those of Holland, were particularly well suited to some parts of the worsted manufacture.

The combing-wools from Germany were coarse and harsh, and only used in default of other supplies. Very fine worsted yarn was also obtained from Saxony and the environs of Gottingham; but this yarn was tender, and required to be mixed with worsted yarn from English or Dutch wool. The yarn of Turcoign was supposed to be Dutch, but was principally from Flanders and Artois. The goat’s-wool came from the Levant, by way of Marfellies, in bales of from 200 to 300 lbs. It fold from four livres to twelve livres per French pound; the price of that mott generally used was about 4 livres 10 sous per pound. The fikls used in silk camelots, &c. were obtained from Paris and Lyons.

The following table gives the quantity and value of wool yarns and worsted pieces in Picardy; but he supposes the quantity to be under the real amount, the manufacturers concealing the extent of their trade to avoid arbitrary taxation.

Wool consumed in the Worsted Manufacturies of Picardy.

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>French wool</td>
<td>3200000</td>
<td>3520000</td>
</tr>
<tr>
<td>Dutch ditto</td>
<td>180000</td>
<td>36000</td>
</tr>
<tr>
<td>English ditto</td>
<td>200000</td>
<td>32000</td>
</tr>
<tr>
<td>German ditto</td>
<td>100000</td>
<td>11000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>368000</strong></td>
<td><strong>431000</strong></td>
</tr>
</tbody>
</table>

Yarn imported.

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yarn of Turcoign</td>
<td>60000</td>
<td>51000</td>
</tr>
<tr>
<td>German yarn</td>
<td>100000</td>
<td>70000</td>
</tr>
<tr>
<td>Levant yarn, or</td>
<td>220000</td>
<td>1210000</td>
</tr>
<tr>
<td>Mohair</td>
<td>20000</td>
<td>70000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>743000</strong></td>
<td></td>
</tr>
</tbody>
</table>

Brought
WOOLLEN MANUFACTURE.

Brought forward - - - - 7430000
Combining and spinning 3680000 lbs. of wool 4310000
Winding, warping, and weaving - - - - 4770000
Dyeing of wool and pieces - - - - 1900000
Profit of the wool-dealers, manufacturers - - - - 1300000

Total value of 1500000 pieces coming from the manufacturer - - - - 12800000
Value of dyeing-wares - - - - 500000
To which carriage and profit of the merchant and draper - - - - 2000000

Total value of worsted goods in Picardy - - - - 20500000

One million and fifty thousand pounds weight of wool were also consumed in hosiery in the same province, of which the greatest part was native; and the remainder about two hundred and fifty thousand pounds weight from Holland. The number of working manufacturers in Picardy is thus stated:

50000 men who gain 140 livres per annum - - - 7000000
50000 women - - - - 3500000
150000 children - - - - 6000000

The greater part of the manufacturers resided in the country, and were employed part of the time in agriculture; this was also the case with the manufacturers in the towns, so that not more than eight months in the year were devoted to manufactures. This change of employment, so conducive to the health and comfort of the labouring classes, may be regarded as presenting the happiest form under which manufactures can be carried on. This was also in a considerable degree the situation of the woolen and worsted manufacturers in Yorkshire, before the late introduction of machinery had driven the population into large factories; a change which may be regarded as one of the greatest evils that ever afflicted civilized society, tending directly to degrade and enfeeble the human race, and to render man a wretched machine, a prisoner from the cradle to the workhouse or the grave, devoid of moral feeling and physical energy.

What was the extent of the worsted manufacture in the other provinces of France where it was carried on, we have no correct means of ascertaining. In the middle of the last century, the export of cloths and worsted goods from Languedoc alone amounted annually to about 60,000 pieces, sent to the Levant and to Barbary. At that time also, Spain, and all the countries bordering the Mediterranean, received worsted goods from France. In the variety of worsted articles, in the ingenuity of the patterns, and the superiority of the workmanship, as well as of the dyes, France may be regarded as having surpassed any other nation in Europe, prior to the year 1785, or about the close of the American revolution. Since that period, the manufactories of England have advantageously increased, and have obtained a decided preference in foreign markets.

The woolen manufactories of Saxony and Germany have been long established; the fugitives from the edict of Nantz contributed much to improve and extend them. During the late war, all the manufactories in Germany and every part of the European continent suffered greatly, but are at present rapidly reviving, and will abridge the amount of our exports in Europe.

In Russia, Sweden, and Denmark, the woolen manufacture, as a distinct occupation, is comparatively new; yet it has existed long enough to produce great alteration in their flocks. And as this change was attempted in a more enlightened period, and conducted by scientific men, the best means were adapted to promote the improvement, and new breeds of sheep have been introduced into both countries. The same remark applies to Saxony and other circles of the German states, and even Hungarian flocks are not without evident indication of a change for the better.

Of the worsted manufacture as distinct from the woolen, we have little information respecting its origin. It comprises all those goods made of combed wool in distinftion from carded wool. We are unacquainted with the period when the wool-comb was invented, or when worsted goods were first manufactured. It is probable, that worsted goods were originally woven in the East, and that the knowledge of them was brought into Europe either by the Armenian merchants, or those who returned from the extravagant expeditions which were undertaken for the recovery of the Holy Land from the dominion of the infidels. The garments which are now worn by the Turks, some of which seem to have been produced by means of the comb, the incidental mention of that instrument in an account which we have of Angora, and the demand for worsted goods through the Levant, confirm the conjecture, and lead us to suppose, that there exist very considerable manufactories of this kind in the Turkish empire, although we know little more of its domestic and rural condition, than can be obtained from the most vague accounts and uncertain deductions. After the art of spinning worsted yarn was known in the west of Europe, the looms of the Netherlands became active in converting it into those peculiar kinds of goods to which it was adapted, and it seems, as though the distinction between these and woolen articles was not generally noticed until some years afterwards. It might have been expected from the nature of the article, that the manufacture of worsted goods should in many southern countries have preceded that of cloth. Long-flapied wool suited to the comb seems more spontaneously the produce of uncultivated sheep, than flort wool, which is to be manufactured by carding, and its mode of manufacture more nearly resembles that of flax; hence it is not improbable, that worsted goods were made in Egypt and the East before the manufacture of woolen cloth. This is, however, uncertain.

In the manufacture of long wool, the fibres are arranged parallel to each other, like those of flax; but before they are spun, they require to be laid even by some kind of instrument, which shall separate the fibres, that they may draw out evenly in spinning. A comb of a very simple construction, with a few wires for the teeth, was probably first made use of. It was afterwards found, that the application of heat to the comb contributed more effectually to the regular arrangement of the fibres; and thus the invention of the common wool-comb arose, but at what period is unknown. Virgulian tradition ascribes the invention to bishop Blake, who first used it in Alderney; but there does not appear any authority in support of this opinion. The bishop lived in Armenia, and was raised to the episcopal dignity about the time of Diocletian, and suffered martyrdom under that tyrant. Before he was beheaded, he was tortured with iron combs, with which his flesh was torn; and hence when an instrument of that kind was brought into common use, the workmen chose him for their patron saint. The traditions of the origin and progress of the worlde manufacture are thus extremely imperfect; we shall have occasion to speak of its introduction and progress in this country in the following section.
WOOLLEN MANUFACTURE.

Rise and Progress of the Woollen Manufactures in England.

The Romans, as we have stated on the authority of Camden, had a cloth manufacture at Winchelsea. The first account of any distinct body of manufacturers afterwards occurs in the reign of Henry I., but either the people of this country were wholly clothed in skins or leather in the intervening space, or, what is more probable, coarse cloths were manufactured in a rude manner in most of the towns and villages in England. A great part, however, of the drefs of the labouring classes in the country was made of leather, particularly the breeches and waistcoats, and even the till the present reign. George Fox, the founder of the Quakers, in the reign of Charles II., travelled on his missions through the country, buttoned up a leather doublet, or waistcoat with sleeves, which supplied the place of a coat. This was not, as his adversaries afterwards affirmed, from any superstitious prejudice respecting that costume; it was the common drefs of the labouring mechanics at that time, to which clafs he belonged.

The first account of any foreign weavers settled in England is recorded by William of Malmesbury and Giralalus Cambrensis, who relate that a number of Flemings were driven out of their own country, by an extraordinary encroachment of the sea in the time of William the Conqueror. They were well received, and first placed in the neighbourhood of Carlifhe, and on the northern frontier; but not agreeing with the inhabitants, they were transplanted by Henry I. into Pembrokeshire. They are said to have been skilful in the woollen manufacture, and are supposed to have first introduced it into England as a separate trade. Cloth-weavers are mentioned in the exchequer accounts as cxisting in various parts of England in the reign of Henry I., particularly at London and Oxford. The weavers of Lincoln and Huntingdon are represented as paying fines for their guild in the 5th of Stephen; and in the reign of Henry II. (i189), there were weavers in Oxford, York, Nottingham, Huntingdon, Lincoln, and Winchelsea, who all paid fines to the king for the privilege of carrying on their trade. (Chronicon Pretoleum, p. 64.) There were also cloth dealers in various parts of Yorkshire, Nortwich, Huntingdon, Gloucester, Northampton, Nottingham, and Newcalf-te-Tyne; also several towns in Lincolnshire, and at St. Alban's, Baldock, Berkhamstead, and Chelfterfield, who paid fines to the king that they might freely buy and sell dyed cloths. These are supposed to have been cloths imported from the Flemings. The red, scarlet, and green cloths, enumerated among the articles in the wardrobe of Henry II., were most probably foreign, as the English had attained little skill at that time in the art of dyeing. Madox's History of the Exchequer.

In the 31st of Henry II. the weavers of London received a confirmation of their guild, with all the privileges they enjoyed in the reign of Henry I.; and in the patent he directed, that if any weaver mixed Spanish wool with English in making cloth, the chief magistrate should seize and burn it. (Stowe's Survey of London.) This absurd edict was illused under the pretext of the inferiority of the Spanish wool, but was doubtless intended to encourage the growth of English wool, an article from which our kings derived a considerable revenue. The circumstance rather proves the superior excellence of Spanish wool at that time, and the jealousy which its importation had excited among the English wool-growers.

In the reign of Henry III. an act was passed limiting the breadth of broad-cloths, ruffets, &c. to two yards within the lifts. In the year 1283, foreign merchants were first permitted to rent houses in London, and buy and sell their own commodities, without any interruption from the citizens. Previous to this date they hired lodgings, and their landlords were the brokers, who sold all their goods, and received a commission upon them. It was soon after pretended that the foreign merchants used false weights, and a clamour being raised against them, twenty of them were arrested and sent to the Tower. Amidst the numerous absurd restrictions to which commerce and manufactures were subjected, we need not be surprized at the little progress which they made.

The materials which history affords respecting the woollen manufacture before the reign of Edward III. are but scanty; it appears that the office of aulnager, or cloth inspector, was very ancient. In the reign of Edward I. we are informed by Madox, that Peroult le Tayleur, who held the office of aulnager of cloth in the several fairs of the realm, having forfeited it, the king, by writ of privy seal, commanded the treasurer to let Pierre de Edmundon have it, if he were fit for it, and a writ was made out accordingly, and he took the oaths of that office before the treasurer and barons. The facts above stated prove the existence of the cloth manufacture in England before the time of Edward III., who is generally supposed to have first introduced the art into the kingdom. There is no doubt, that a new impulsion was given to it during this reign by the liberal protection granted to foreign manufacturers here; in all probability, they first introduced the manufacture of stuffs from combed wool or worsteds; an art requiring more skill, and more complicated processes, than are employed in the making of cloth.

In the year 1331, John Kemp, a master manufacturer from Flanders, received a protection to establish himself here with a number of dyers and fullers to carry on his trade, and in the following year several manufacturers came over from Brabant and Zealand. It is said, that the king's marriage with the daughter of the earl of Hainault enabled him to fend out emiaries without suspicion, to invite the manufacturers to this kingdom. These manufacturers were distributed over the country, at the following places:—The manufacturers of futlains (woollen) were established at Norwich, of baize at Sudbury in Suffolk, of fyes and ferges at Colchelter in Exef, of broad-cloths in Kent, of kerbies in Devonshire, of cloth in Worecefterhire and Gloucefterhire, of Welsh frieses in Wales, of cloth at Kendal in Westmoreland, of coarse cloths, afterwards called Halifax cloths, in Yorkhire, of cloth in Hampshire, Berk- shire, and Sufex, and of ferges at Taunton in Devonshire. (Rymer's Fædera, vol. i. p. 19.) Freth supplies of foreigners contributed to advance the woollen trade of these directions.

Kendal, in Westmoreland, claims the honour of first receiving John Kemp, where his descendants still remain, and the woollen trade is at present carried on. In the following reign, we find the manufacturers of Kendal petitioning to be relieved from the regulations imposed on broad-cloths. Kendal green is mentioned by Shakfpeare as an article of drefs in the time of Henry IV., and there is reason to believe, that in the reign of Elizabeth, the woollen manufactures of that town were as extensive as at present.

In the year 1336, two woollen manufacturers from Brabant settled at York, under the king's protection: they are stated in the letters of protection, "Wilhelmus de Brabant & Hanckinus de Brabant, Textores." These persons probably laid the foundation of the woollen and worsted manufactures, which have since been extensively flourished in the western part of that country. It is not very improbable, that the manufacturer Hancks, called Hanckinus,
WOOLLEN MANUFACTURE.

The references which we have soon afterwards to the woolen manufacture, as existing in the districts before-named, tend to confirm the belief, that the distribution of the foreign manufacturers we have given is correct. About this time, we learn that Thomas Blanket, and other inhabitants of Bristol, set up looms in their own houses, but were so harassed by the impositions of the mayor and bailiffs of the place, that they were obliged to obtain letters from the king to permit the free use of their trade, without impediment, caluny, or exaction. The letter to the mayor and bailiffs accuses them in the following terms: "vos diversa pecunia summas ab eodem Thomas et aliis exigis et ea occassione multipliciter inquietatis et gravatis, ut afferunt." Dr. Parry has conjectured, that blanket, which at first meant a coarse white undressed cloth, derived its name from the same Thomas Blanket of Bristol. The encouragement given to the woolen manufacturers during this reign, and the consequent consumption of wool at home, diminished the export of it so much, that a duty was laid on cloth exported to supply the place. Blackwell-hall was appointed by the mayor and common council of London for the market, where cloth manufacturers might fend their goods for sale, in the year 1357.

In the course of the reign we find several other acts relating to the measurement and fulling of cloth, and the fees to be paid to the alnerger.

In order to form a more distinct idea of the relative value of wool, cloth, and other articles, after and before the reign, it may be proper to refer to the state of the silver coinage.

The 28 Edward I. one shilling contained 264
18 Edward III. - - 236
27 Edward III. - - 213
9 Henry V. - - 176
1 Henry VI. - - 142
4 Henry VI. - - 176
49 Henry VI. - - 142
1 Henry VIII. - - 118
34 Henry VIII. - - 100
36 Henry VIII. - - 60
37 Henry VIII. - - 40
3 Edward VI. - - 40
5 Edward VI. - - 40
6 Edward VI. - - 88
2 Elizabeth - - 89
43 Elizabeth - - 86
at which it continued to the present reign.

The following account of the imports and exports in the 28th of Edward III., fail to be found in a record of the exchequer, was published by Edward Miffeldon, merchant, in the year 1623.

**Exports.**

<table>
<thead>
<tr>
<th>Amount</th>
<th>£  s. d.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thirty-one thousand five hundred and fifty: one sacks and a half of wool, at six pounds value each sack, amount to</td>
<td>189,909 0 0</td>
</tr>
<tr>
<td>Three thousand thirty-five hundred and sixty-five felt at 40s. value, each hundred at fix score, amount to</td>
<td>6,073 1 8</td>
</tr>
<tr>
<td>Whereof the custom amounts to</td>
<td>81,624 1 1</td>
</tr>
<tr>
<td>Fourteen laft, seventeen dicker, and five hides of leather, after six pounds value the laft, amount to</td>
<td>89 5 0</td>
</tr>
<tr>
<td>Whereof the custom amounts to</td>
<td>6 17 6</td>
</tr>
<tr>
<td>Carried forward</td>
<td>277,702 5 3</td>
</tr>
</tbody>
</table>

**Imports.**

<table>
<thead>
<tr>
<th>Amount</th>
<th>£  s. d.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Four thousand seven hundred and seventy-four cloths and a half, after 40s. value the cloth, is</td>
<td>9,549 0 0</td>
</tr>
<tr>
<td>Eight thousand and sixty-one pieces and a half of workeled, after 16s. 8d. value the piece, is</td>
<td>6,717 18 4</td>
</tr>
<tr>
<td>Whereof the custom amounts to</td>
<td>215 13 7</td>
</tr>
</tbody>
</table>

**Summary of the out-carried commodities in value and custom**

<table>
<thead>
<tr>
<th>Amount</th>
<th>£  s. d.</th>
</tr>
</thead>
<tbody>
<tr>
<td>One thousand eight hundred and thirty-two cloths, after six pounds value the cloth</td>
<td>10,922 0 0</td>
</tr>
<tr>
<td>Whereof the custom amounts to</td>
<td>91 12 0</td>
</tr>
<tr>
<td>Three hundred and ninety-seven quintals and three quarters of wax, after the value of 40s. the hundred or quintal</td>
<td>795 10 0</td>
</tr>
<tr>
<td>Whereof the custom is</td>
<td>19 17 0</td>
</tr>
<tr>
<td>One thousand eight hundred and twenty-nine tons and a half of wax, after 40s. per ton</td>
<td>3,659 0 0</td>
</tr>
<tr>
<td>Whereof the custom is</td>
<td>182 0 0</td>
</tr>
<tr>
<td>Linen cloth, mercury, and grocery-wares, and all other manner of merchandise</td>
<td>23,014 16 0</td>
</tr>
<tr>
<td>Whereof the custom is</td>
<td>285 18 3</td>
</tr>
</tbody>
</table>

**Summary of the in-brought commodities, in value and custom, is**

<table>
<thead>
<tr>
<th>Amount</th>
<th>£  s. d.</th>
</tr>
</thead>
<tbody>
<tr>
<td>38,970 13 3</td>
<td></td>
</tr>
</tbody>
</table>

**Summary of the impulmage of the out-carried above the in-brought commodi-**

ties, amounteth to | 255,214 3 11

Admitting the correctness of this statement, which we have no reason to doubt, we must observe, that the cloth imported was of a higher value per yard than the cloth exported. Hence it may be inferred, that for several years after the arrival of the Flemish weavers, we were partly dependent on foreigners for our fine cloths; the coarser kinds then, as at the present day, forming the larger quantity of our exports. It is obvious also, that wofelled goods had become an article of manufacture, nearly equal in importance with the woolen; and hence it is not improbable, that the greater part of the Flemish manufacturers were makers of satins and wofelled goods, which was probably an entirely new trade in England.

The statutes in the following reigns, relating to the woolen manufacture, prove the narrow and selfish policy by which the manufacturers were influenced: these statutes refer either to restrictions which they wanted to impose, in order to confine the trade to themselves, or are made to prevent them from fraudulently packing or weaving their goods. In conformance of these fraudulent practices, the 13th statute of Richard II. makes the following regulations, which are curious, as marking the spirit of the manufacturers, and also as proving the early establishment of the woolen trade in the western counties, where it now flourishes. It runs thus: "Forasmuch as divers plain cloths, wrought in the counties of Somerset, Dorset, Bristol, and Gloucester, be tacked and folded together for sale; of which cloths a greater part be broken, bruised, and not agreeing in the colour, neither according to the breadth, nor in no manner to the part of the fame cloths shewed outwards, but falsely wrought with divers woolls, to the great loss and damage..."
WOOLLEN MANUFACTURE.

In the year 1493, in consequence of a quarrel between Henry VII. and the archduke Philip, all intercourse between the English and Flemish ceased, and the market for English goods was transferred from Antwerp to Calais. This interruption to the regular course of trade was severely felt by the woollen manufacturers. Lord Bacon, mentioning the renewal of the trade with Flanders, which took place again in 1496, says, "By this time the interruption of trade between the English and Flemish began to pinch the merchants of both nations very sore. The king, who loved wealth, though very fensible of this, kept his dignity so far as first to be sought unto. Wherein the merchant adventurers likewise did hold out bravely; taking off the commodities of the kingdom, though they lay dead upon their hands for want of vent." The merchant adventurers he describes as "being a strong company, and underlet with rich men." It is not, however, very probable, that this company would continue to purchase goods without a prospect of gain. These merchant adventurers were divided into two bodies; those of London, which were the most powerful; and the merchant adventurers of England, who paid a fine to the former on all goods sold at the foreign marts.

In the reign of Henry VIII. the woollen trade, particularly all kinds of worsted manufactures, appear to have been in a very flourishing state, though trade suffered several severe checks from the wars in which we were engaged. In the year 1527, Henry having entered into a league with France against the emperor Charles V., all trade with Spain and the Low Countries ceased. The goods sent to Blackwell-hall found no purchasers, the merchants having their warehousers filled with cloths; the poor manufacturers being thus deprived of employment, an insurrection took place in the county of Suffolk, where four thousand of them assembled, but were appeased by the duke of Norfolk. The merchants were summoned to appear before cardinal Wolsey, who in the name of the king reprimanded them in an angry tone for not purchasing the goods brought to market, and threatened them that his majesty would open a new mart at Whitehall, and buy of the clothiers to fall again to foreign merchants; to which menace one of them pertinently replied, "My lord, the king may buy them as well at Blackwell-hall, if it please him, and the strangers will gladlier receive them there than at Westminster."—"You shall not order that matter," said the cardinal; "and I shall send into London to know what cloths you have on your hands, and by that done, the king and his council shall appoint who shall buy the cloths, I warrant you." With this answer the Londoners departed. Grafton's Chronicle, vol. ii. p. 1167-8.

The interference of the cardinal raised the spirit of the manufacturers for a time, but originating in ignorance of the nature of trade, it could only have a temporary effect, and goods fell again till a truce between England and Flanders was made for the benefit of trade. This fact shews the dependance of England, even at that time, on the export of manufactured woollens. In this reign we find Lancashire and Cheshire first named as seats of the manufacture of coarse woollens; they are mentioned, together with Cornwall and Wales, as districts where cloths were made. It appears from various references, that Norfolk and Suffolk were then flourishing seats of the worsted manufacture, and of all goods made with a worlde warp. Wardens were allowed to the towns of Yarmouth and Lynn, but with a selfish restriction, that the pieces were to be dyed, spun, or callendered in the city of Norwich. In the last year of this reign, an act was passed to prevent any persons...
WOOLLEN MANUFACTURE.

persons besides woollen manufacturers, who bought wool for their own use, and merchants of the staple, who bought for exportation, to purchase wool with the intent to sell again. This act extended to twenty-eight counties, and secured a monopoly of the wool to the merchants of the staple, and to the rich clothiers. In the first year of the following reign, Edward VI., it was repealed, so far as to allow every person dwelling in Norwich and Norfolk, to buy wool the growth of that county, by themselves or agents, and retail it out in open market. The reason assigned is this: That almost the whole number of poor inhabitants of the county of Norfolk and city of Norwich had been used to get their living by spinning of Norfolk wool, which they used to purchase by eight pennyworth or twelve pennyworth at a time, selling the same again in yarn; and because the grower chose not to parcel it in such small quantities, therefore for the benefit of the poor, the wool of Norfolk was allowed to be purchased by wool-dealers. By this act, the 33d of Henry VIII., for prohibiting the exportation of yarn is made perpetual. The manufacture of woollens in the counties adjoining London appear to have been extensive, particularly in the county of Berkshire; for in the beginning of the reign of Henry VIII., John Winchcombe, of that county, commonly called Jack of Newbury, was celebrated as the greatest clothier in England. He kept one hundred looms in his own house, and in the expedition against the Scotch, he sent to Foddenfield one hundred men, fully equipped, at his own expense. Even so early as the 13th century, one Thomas Cole was distinguished by the name of the rich clothier of Reading, in Berkshire.

York, the second city in the kingdom, and from its connexion with the port of Hull well situated for the export trade, was probably an early seat of the woollen manufacture. We have already mentioned the settlement of two clothiers from Brabant in the time of Edward III. We do not learn precisely in our early historians, when the manufactures emanated from that city into the western parts of the county; but from an act in the 34th of Henry VIII. we are informed, that the chief manufacture of that city was the making of coverlets; the act recites, "that the poor of that city were daily employed in spinning, carding, dyeing, weaving, &c. for the making of coverlets, and that the same have not been made elsewhere in the said county till of late; that this manufacture had spread itself into other parts of the county, and was thereby debased and discredited, and therefore it is enacted, that none shall make coverlets in Yorkshire but the people of York." Thus we see, under the thinly pretext of public benefit, the manufacturers were willing to disguise that selfish spirit of monopoly, which disgraces almost every page of our commercial history. The municipal regulations of the city of York, which were, and still continue to be, hostile to a free trade, probably obliged many manufacturers, who were not sharers in the monopolies of the guild, to establish themselves in the western villages of the county, where provisions were cheaper, and where they could carry on their trade without restriction. In the reign of Philip and Mary, soon after this period, we have the following interesting account of Halifax, in consequence of an act passed in the 37th of Henry VIII. to prevent any other persons than merchants of the staple and woollen manufacturers from buying wool in the county of Kent and twenty-seven shires. The poorer manufacturers, who were unable to lay in their flock of wool at one time, being hereby deprived of their trade, made application for redress, which was granted. The act recites as follows: "Whereas the town of Halifax being planted in the great wafe and moors, where the fertility of the ground is not apt to bring forth any corn nor good grass, but in rare places, and by exceeding and great industry of the inhabitants; and the same inhabitants altogether do live by cloth-making, and the greater part of them neither getteth corn, nor is able to keep a horse to carry wool, nor yet to buy much wool at once, but hath ever used to repair to the town of Halifax, and there to buy some two or three fote, according to their ability, and to carry the same to their houses, three, four, or five miles off, upon their heads and backs, and to make and convert the same either into yarn or cloth, and to sell the same, and to buy more wool of the wool-driver; by means of which industry, the barren grounds in those parts be now much inhabited, and above five hundred households there newly increased within these four years past, which now are like to be undone and driven to beggary by reason of the late statute (37th of Henry VIII.) that taketh away the wool-driver, so that they cannot now have their wool by such small portions as they were wont to have, and that also they are not able to keep any horses whereupon to ride or fetch their wool further from them in other places, unless some remedy may be provided. It was therefore enacted, that it should be lawful, to any person or persons inhabiting within the parish of Halifax, to buy any wool or woolens at such time, as the clothiers may buy the same, otherwise than by enrolling and forecasting, so that the persons buying the same do carry the said wool to the town of Halifax, and there to sell the same to such poor folks of that and other parishes adjoining, as shall work the same in cloth of yarn, to their knowledge, and not to the rich and wealthy clothier, or any other to sell again. Offending against this act to forfeit double the value of the wool so sold."

From this we learn that many woollen manufacturers had been either driven from York at an early period, by the oppression of the municipal regulations, or had retired where provisions were cheaper, and where they had better streams for the erection of fulling-mills, and for other processes of the manufacture, such as dyeing and scouring.

The woollen manufactures also gradually retired from the vicinity of the metropolis, owing to the increased price of provisions and labour, and probably also to the difficulty of obtaining commodious streams for the scouring and fulling of cloth, when the country round London became more populous. In the latter part of the reign of Henry VIII. we are informed, that the king demised to William Webbe the subsidy andaulage of all cloth made in the county of Monmouth, and in the twelve shires of Wales. A former act of this reign, speaking of the manufacturers of North Wales, says, they had been used to sell their cloths so craftily and hard rolled together, that the buyer could not perceive the untrue making thereof. These acts prove the extension of the woollen manufactures westward.

In the same reign, an act mentions the woollen manufactures as being established in Worcestershire, but prohibits any one from making cloth in the county, except within the city of Worcester, and in the towns of Evesham, Droitwich, Kidderminster, and Bromsgrove; and forbids the owners of houses in those places from letting them at advanced prices to the cloth-manufacturers. The woollen manufacture has continued to the present day at the two last of these towns. In the reign of Edward VI. Coventry and Manchester are mentioned as manufacturing places. The manufacturers in the old established feats of the woollen trade appear to have been greatly alarmed at the extension of the cloth manufacture, and to have exerted all their influence to restrain it. Near the conclusion of the reign of Philip
Philip and Mary, an Act in 53 sections was passed, relating to the making of woolen cloths. It enacts, that no person shall make woolen cloth but only in a market-town, where cloth hath commonly been used to be made for the space of ten years last past, or in a city, borough, or town corporate. From this restricting Act, however, the following exceptions are made: to all persons who dwell in North Wales or South Wales, Cheshire, Lancashire, Cornwall, Northumberland, Cumberland, Northumberland, the bishopric of Durham, Salford, Warrington, Calder, York, and any other town or city in England, being within twelve miles of the city of York, or any towns or villages near the river Wharfe in Yorkshire. This Act, so absurd and oppressive, was obliged to be modified in the first year of the following reign, by an Act entitled "An Act for the continuing and making of Woolen Cloths in divers Towns in the County of York." Bocking, Wetherfold, Cockshill, and Dodham, are the towns specified.

In consequence of the increase of our manufactures, the export of wool had nearly ceased before the reign of Elizabeth; and a considerable advance appears to have taken place in the price of food, clothing, and rents. The export trade of England was carried on very extensively by three companies of merchants, the merchants of the Stillyard, who were foreigners, the merchants of the Staple, and the merchant adventurers, who were English. See Stillyard, Staple, and Adventurers.

The merchants of the Stillyard were of ancient standing, and were originally from the Hanse towns; they had great privileges granted them, and particularly they were allowed to export and import all wares and merchandise, on payment of the small duty of one and a quarter per cent. This gave them a decided advantage over the other companies; and it is alleged that they lent their name to cover the import and export of goods belonging to private merchants, and thereby evaded the regular duties on such goods. This company had engrossed a considerable part of the cloth trade. In the year 1531 they exported 44,000 cloths, soon after which this company was dissolved. The merchant adventurers succeeded to that branch of their trade; according to the account of John Wheeler, secretary to the company, there were annually shipped by them 30,000 white cloths, worth 600,000l., and 40,000 cloths of all sorts, baizes and kerseys, worth 400,000l., besides wool and woollens. We are told by Camden, that, in this reign, the commerce between England and the Netherlands rose to above twelve millions yearly, and the woolen trade alone amounted to five millions. The Latin terms by which Camden employs, milliones aureorum, leaves the amount intended uncertain; if we suppose it to be ducats, the quantity is much greater than England exported at that time; probably florins were intended, which makes the amount about 750,000l.

Besides the exports to Antwerp, English cloth was at this time sent to Amsterdam, Hamburg, Sweden, Russia, and other countries. The woolen trade of England had now advanced to a higher state of prosperity than at any former period; and from this time it appears to have declined until after the revolution of 1688. In this reign, the price of wool, which we believe to mean long or combing wool, had advanced from 15s. 4d. to 22s. per toad; and the shilling containing the same weight of silver as our late coinage, viz. 86 grains, the relative value of a tod of long wool was considerably more than it has ever been during the present reign.

The decline of our manufactures in the succeeding reigns of the Stuarts, as we have reason to believe, extended much more to woolen cloths than to woofed pieces. Long wool, or combing-wool, was more the peculiar produce of England than clothing-wools. The latter were grown in abundance, and of a superior quality, in Spain, Portugal, and France; but the combing-wools of England, on account of the superior foundness of the staple or fibre, and the quantity supplied, gave a decided advantage to our manufacturers of stuffs or woofed pieces.

The persecution of the Protestants by the duke of Alva in the Netherlands drove multitudes of the manufacturers into England, where they were graciously received by Elizabeth, who gave them liberty to settle at Norwich, Colchester, Sandwich, Maidstone, and Southampton. These refugees contributed to extend our manufactures of woofed goods and light woollens, called bays and fayas; they also introduced the manufacture of linens and silks, and it is supposed that they first taught the art of weaving on the rock-fig frame.

In the latter part of the reign of Elizabeth an Act was passed to relieve the counties of Somerset, Gloucester, and Wilts, from those absurd and oppressive statutes which confined the making of cloth to corporate towns. This Act, which gave to all persons residing in these counties the privileges of free trade, could not fail to extend and establish the woollen manufactures in these parts, and they have remained to the present time the principal seats of the superfine cloth trade, whilst many manufacturing corporate towns, which were then flourishing, have sunk to decay. Various acts, regulating the length, breadth, and tentering of woollen goods of different kinds, were also passed in this reign, referring to the counties of Oxfordshire, Devon, and the counties north of Trent, particularly York and Lancashire. The importation of foreign wool-cards was also prohibited. The Act recites, that many thousands of woollen card-makers and card-board makers, living in London, Bristol, Gloucester, Norwich, Coventry, and elsewhere, had hitherto subjected themselves and families upon that business, which was now greatly impaired by the importation of wool-cards. No laws prohibiting the export of wool were thought necessary in this period of our history, and it continued to be exported during the whole of this reign, as appears by the account of the merchant adventurers, who exported it together with cloth; but though wool was freely exported, an Act was passed to prevent the carrying of live sheep, lambs, or rams out of England; but the reasons for this Act are not recited, though it states it was for divers good causes and considerations. The internal tranquillity that the country enjoyed during this long reign, the influx of foreign makers of new kinds of woofed, and other articles not known before, the opening of a new trade to Turkey and the Barbary states, by treaty in the year 1579 and in 1583, all greatly contributed to the extension of the woolen trade and manufactures. There were indeed other circumstances which must have operated against our manufacturers in part of this reign. The interruption of commerce between England and the Netherlands in 1564, which lasted some time, the wars with Spain, the faking of Antwerp, in which the English merchants suffered severely, gave a considerable check to the foreign trade; yet we have seen that the merchant adventurers alone exported woollens to the amount of one million sterling towards the latter end of this reign. The demand at home for woollens must also have greatly increased during the long period of domestic tranquillity which the nation at that time enjoyed, and particularly from the prevailing taste for costly dresses which has spread from the court through the country.

A great part of our woolen exports hitherto consisted of white undressed cloth; but in the following reign of James I. it was represented as bad policy to permit the exportation of cloth in this state, and thereby lose the profit on the dyes.
dyeing and finishing. A letter exists addressed to king James on this subject, ascribed to Sir Walter Raleigh, but without sufficient evidence, as "the most ancient manuscripts of this letter in the libraries of the nobility ascribe it to John Keymer." (Oldy's Life of Sir W. Raleigh.) In this letter it is stated, "that there have been eighty thousand undressed and undyed cloths exported yearly, by which the kingdom has been deprived of four hundred thousand pounds for the last fifty-five years, which is nearly twenty millions that would have been gained by the labour of the workmen in that time, with the merchants' gains for bringing in dyeing-wares, and return of cloths dressed and dyed, with other benefits to the realm." The writer proceeds, in another part, to state that there had also been exported in that time annually, of baizes and northern and Devonshire kerseys, in the white, fifty thousand cloths, counting three kerseys to a cloth, whereby had been lost about five millions to the nation in labour, profit, &c. The author informs us, that the baizes so exported were dressed and dyed at Amsterdam, and shipped to Spain, Portugal, and other kingdoms, under the name of Flemish baize, setting their own seal upon them; "so that we lose the very name of our home-bred commodities, and other countries get the reputation and profit thereof." The author concludes with asserting, that the nation loses a million a year by the export of white cloths, which might be dressed and dyed as well at home. This letter has been often quoted as containing unanswerable reasons for confining the whole procee of the cloth manufacture to our own country; but, like other monopolists, the writer seems to forget that there are two parties in all mercantile transactons, and that manufactured goods must be sent in that state in which the purchaser is willing to receive them, unless it be proved that he cannot procure them elsewhere. Let us mark the refult. Alderman Cockayne, and other London merchants, had sufficient influence with the government to obtain the prohibition of the export of white cloths, and to secure a patent for dressing and dyeing of cloths. In consequence of which, the Dutch and Germans immediately prohibited the importation of dyed cloths from England, which gave so great a check to our export trade, that in the year 1616, the whole amount of cloths exported of every kind amounted only to sixty thousand, so that the export trade in woollens had fallen to less than one-third of its former amount; and in the year 1622,

<table>
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<tr>
<td>All our exports of every kind amounted only to</td>
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<tr>
<td>Whilist our imports were</td>
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<td>Leaving a balance against us of</td>
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It being from experience proved, that the policy of dressing and dyeing all our goods at home had produced the greatest injury to the woolen trade, the restrictions were taken off, and the export for white cloth left free. In the former reign, cloths about four pounds value were, by statute, to be sent out dyed, by all persons except the company of merchant adventurers, who obtained a licence to export all sorts of white cloths; and though this was itself a monopoly, yet, as it gave foreigners an opportunity of receiving our finer cloths in the state in which they mott wanted, it was the means of increasing our trade; indeed it is said by Miffielden, that "within a few years after granting this licence, the vent for cloth in foreign parts increased to twice as much as it had been during the strict observance of the statute." With this fact before their eyes, it is scarcely possible that our statesmen at that time could have proceeded to the prohibition of white cloth exports, unless they had been (as was asserted) influenced by presents from alderman Cockayne and the rich merchants, who expected to receive the benefit arising from the prohibition, and the exclusive right of dyeing and dressing. The wool-growers equally felt the ill effects of this prohibition. Wool is said to have fallen from thirty-three shillings per tod to twenty shillings; if by this is meant the long combing-wools, the former price, considering the value of money at that time, is much higher than it has been in the last or the present century.

During the reigns of the Stuarts, the infamous policy they adopted struck not only at the liberty, but at the commercial prosperity of the country. Archibishop Laud, imbued with the malignant zeal of a bigot, commenced his attacks on the descendants of the French Protestant, established as manufacturers of woollens in Norfolk and Suffolk, from which counties his persecuting fury drove some thousand families. Many of them settled in New England; but others went into Holland, where they were encouraged by the Dutch, who allowed them an exemption from taxes and rents for seven years. In return for this, the flaters were amply repaid by the introduction of manufacturers, with which they were before unacquainted. In the year 1622, king James issued a proclamation to prohibit the exportation of wool, fuller's-earth, &c. In 1640 wool was again admitted to be exported on the payment of certain duties; and we are told, that in the same year sir John Brownlowe, of Belton in Lincolnshire, sold three years' wool at twenty-four shillings per tod to a baize-maker of Colchester. As it is reasonable to suppose that this was the long combing-wool of that county, it shews the high relative price of the article at that time. In 1647, owing to the high price of wool, its exportation was again prohibited.

During the civil wars, the manufactures and export trade of England declined, and the Dutch availed themselves of this to extend their own manufacture and export of woollens, particularly to Spain, from whence they brought fine Spanish wool. At this time it appears, that the woollen manufactories in Poland and Silesia were rapidly increasing; and the English government received information that two hundred and twenty thousand cloths were made there annually, besides considerable quantities made at Dantzic, and in the vicinity.

The duke of Brandenburg, it was also stated to our government, had ordered one hundred thousand ells of Silesia cloth to Königberg for his troops, which had been heretofore supplied with English cloth. The estimation in which our cloth had been held is said to have been lost by negligence in the manufacture, particularly in the spinning and weaving. The Dutch and Poles had a little before this time received a great number of Protaggant manufacturers, who fled from the persecution of the duke of Alva in Brabant and Flanders.

Here it may be proper to remark, that the English as a nation had little intercourse with other parts of the world, except through a few large trading companies: hence they were extremely ignorant respecting the state of foreign countries, and supposed that the cloth trade had been confined to their own country for three hundred years; and they considered the establishment of other manufacturers as a novelty and infringement of their just rights. With these views, it was proposed to obtain a complete monopoly of all the clothing-wool in Spain, in order to prevent the Dutch and other nations from rivaling our manufactories. This is the more extraordinary, as the English had not then learned, like the Dutch, to manufacture Spanish wool, without mixing it with that of their own country. It is needless to say, that
WOOLLEN MANUFACTURE.

the negotiation of Sir William Godolphin for this selfish monopoly of wool was not successful. During the whole reign of Elizabeth, when our woollen manufactures were in the highest state of prosperity, wool and woofels were permitted to be exported. In the reign of James I. and Charles I., when the trade was declining, proclamations were issued to prevent the exportation of wool, and also that of fuller’s-earth. During the commonwealth, an ordinance of parliament was issued to prohibit the exportation of wool and fuller’s-earth, on pain of forfeiture of the wool, and a penalty of 32. per pound on every pound of fuller’s-earth. The first act of parliament which absolutely prohibited the exportation of wool by making it felony, and which could not be set aside by a royal licence, is the 12th of Charles II., which was passed soon after the Restoration.

The grounds of this measure are stated in the preamble of the act: “For the better preventing the lofses and inconveniences which have happened by and through the secret and sutable exportation of wool out of the kingdom; and for the better setting to work the poor people and inhabitants of the kingdom, to the intent that the full and best use and benefit of the principal native commodities of the kingdom may redound to and be unto and amongst the subjects and inhabitants of the kingdom, and not unto any foreign states.” Previous to this time, the proclamations and ordinances issued to prevent the exportation of wool, for the most part, signified nothing more than the imposition of a duty or a composition for exporting by licence from the government, what on other terms was forbidden, under penalties of confiscation, fine, or imprisonment. We have seen that, from the death of Elizabeth to the Revolution in 1688, the woollen trade was generally in a languishing state. In the year 1665, Thomas Telham of Warwickshire, with two thousand manufacturers, left the kingdom, and established themselves in the Palatinate, and commenced a woollen manufacture there, and were greatly encouraged by the elector. The establishment was soon afterwards joined by a number of manufacturers from Hertfordshire.

During the period from Elizabeth to the year 1668, the English appear to have made no improvement whatever in their modes of manufacture of woollen cloth, whilst the neighbouring nations had been making a gradual progression, both in the style of their manufacture, and the amount annually produced. It was especially in the manufacture of fine cloths that their superiority was manifest. The Dutch, in particular, were far more expert than the English in the dressing and dyeing of cloth. This will appear from the following remarkable facts stated by Coke, vol. ii. p. 169. In the year 1668, one Brewer, with about fifty Walloons, who wrought and dyed fine woollen cloths, came into England, and received the royal protection and encouragement. By him the English were first instructed how to manufacture cloth of the best Spanish wool, without any admixture with inferior wool; and also to manufacture and dye fine cloths cheaper by 40 per cent. than they had done before. Ten years before this time, it had been published and admitted in England, that “Spanish wool alone could not be wrought into cloth.” It may seem truly extraordinary that the English, who had so long carried on the manufacture of woollen cloth, had not availed themselves of the revolution in Flanders, which drove away the best master manufacturers, to encourage their settlement in this country. M. Huet explains the fact in a way which is not very creditable to the liberality of the English manufacturers, or to the wisdom of our institutions. “It was owing to the municipal laws of England, and its usages towards strangers; who, before being doubly rated at the custom-house, were excluded from all companies or fraternities of trade; and were not allowed to carry on manufactures as masters or partners, unless such as the natives were unacquainted with; so that none of the Flemish master manufacturers of fine cloth went thither (to England); their being a mystery not accounted new, though very much superior to the cloth working then known in England. It was only those who brought in new kinds of worfeds, ferges, damaks, or flockings, who went thither. The same policy was also adopted by the Hanze towns: hence the greater part of the vail and profitable trade, which was lost to Antwerp, centered necessarily in Holland, where the manufacturers from Brabant were cordially received.” This appears a satisfactory explanation why the English, in 1668, were so much inferior to the Dutch in the manufacture of fine cloth.

In the year 1660, however, our manufacturers began to be aware of the superiority of Spanish wool, and to mix it with the best English, probably in what were called medleys or mixture-cloths, or else employing the English wool for warp, and covering it with weft of Spanish wool. The best Spanish wool was then 42. and the second fort 32. per pound, and the best English 12. 6d. per pound.

It is deviating of notice, that, in the latter period of the Commonwealth, our trade was said to have greatly revived, but to have suffered a miserable depression almost immediately after the restoration of Charles II. In a letter of M. Downing of the Hague to the president of the council in London, 1660, printed in Thurlow’s State Papers, vol. vii. p. 848. it is stated, that great quantities of wool were brought secretly from England to Holland; and he adds, that the Dutch had at that time got in a great measure the manufacture of fine cloth, and would probably, with Silesia, engross also the manufacture of coarse cloth, and leave England nothing but its native wool to export.

In the year 1662, great complaints were made against the merchant adventurers for their neglect of the cloth trade; in reply to which they said, that the demand for English cloths failed in the foreign markets, the white clothing trade having abated from 100,000 cloths annually to 11,000. In the year 1663 our whole exports were only about two millions, and our imports four, leaving a balance of two millions against this country. It is, however, deviating notice, that the number of wardens for the inspection of stuffs at Norwich being too few, they were at this time increased from five to eight. A letter on the state of trade, published in 1667, says, clothing-wools were so much fallen at that time, that the best Spanish was sold at 2s. 2d. per pound, and English at 8d. per pound. The writer foresees the fall in the price of English wool to our wearing so much Spanish cloth, a great part not manufactured by ourselves, as Dutch blacks; but it is obvious, from the price of Spanish wool, that the low price of clothing-wools at that time depended on a more general cause, affecting all manufacturing countries. To relieve the cloth trade from the great depression under which it laboured between the years 1660 and 1678, various schemes were devised. Among others, the mayor and common council of London passed an act “for the regulation of Blackwell-hall, Leadenhall, and Welf-hall, (the three public markets for cloth in London,) and for preventing foreigners buying and selling.” By foreigners are understood all persons not free of the city of London. This act, a most singular monument of the ignorance or selfishness of its authors, prohibits the sale of all woollen cloths sent to London, except at the above halls, where certain duties were to be paid upon them, and from whence they could not be removed for three weeks, unless they were sold in the meantime to some draper, or other freeman of the city. The hall-keepers were to attend briefly at the halls, and
WOOLLEN MANUFACTURE.

The alarm and jealousy excited in England by the Irish woollen manufactures produced measures that almost compelled the Irish to export their wool clandestinely to the continent. An act was passed in the year 1699 prohibiting the exportation of woollen manufactures from Ireland, except to a few parts in England and Wales, where the duties imposed amounted to a total prohibition. Various addresses have been presented to the king and both houses of parliament, “beseeching his majesty to take effectual measures to prevent the growth of the woollen manufactures in Ireland.” The Irish parliament was influenced to impose a duty in the same year of four shillings in the pound on their own manufactures when exported. These unjust proceedings were intended to annihilate the export trade for Irish woollens; and, in consequence, their wool and worsted yarn that was not consigned at home were sent to England, or to the continent clandestinely. The first four years after the destruction of their manufactures, these exports to England were as follows:

<table>
<thead>
<tr>
<th>Year</th>
<th>Stone of Wool</th>
<th>Stone of Yarn</th>
<th>Total of Wool and Yarn</th>
</tr>
</thead>
<tbody>
<tr>
<td>1700</td>
<td>336,292</td>
<td>26,617</td>
<td>362,909</td>
</tr>
<tr>
<td>1701</td>
<td>300,812</td>
<td>23,390</td>
<td>324,202</td>
</tr>
<tr>
<td>1702</td>
<td>315,473</td>
<td>43,648</td>
<td>359,121</td>
</tr>
<tr>
<td>1703</td>
<td>360,862</td>
<td>36,873</td>
<td>397,735</td>
</tr>
</tbody>
</table>

The average annual amount of wool and yarn, as above, may be stated at thirty thousand packs. But after this period the exports to England declined, owing no doubt to the clandestine exportation of wool to the continent, for which the numerous creeks and harbours offered such facility.

In 1711, and the three following years, the quantity exported to England was as under:

<table>
<thead>
<tr>
<th>Year</th>
<th>Wool</th>
<th>Yarn</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1711</td>
<td>310,136</td>
<td>52,873</td>
<td>362,909</td>
</tr>
<tr>
<td>1712</td>
<td>263,946</td>
<td>60,158</td>
<td>324,202</td>
</tr>
<tr>
<td>1713</td>
<td>171,871</td>
<td>68,548</td>
<td>240,419</td>
</tr>
<tr>
<td>1714</td>
<td>147,153</td>
<td>58,147</td>
<td>205,290</td>
</tr>
</tbody>
</table>

A few years after this, the decline was still more considerable in the amount of wool exported, but that of yarn continued to increase a little:

<table>
<thead>
<tr>
<th>Year</th>
<th>Wool</th>
<th>Yarn</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1726</td>
<td>51,371</td>
<td>87,261</td>
<td>138,632</td>
</tr>
<tr>
<td>1727</td>
<td>58,182</td>
<td>72,047</td>
<td>130,229</td>
</tr>
<tr>
<td>1728</td>
<td>49,784</td>
<td>80,428</td>
<td>130,212</td>
</tr>
<tr>
<td>1729</td>
<td>38,667</td>
<td>91,154</td>
<td>130,212</td>
</tr>
</tbody>
</table>

A further encouragement to clandestine importation was given by an impolitic duty of 2s. 4d. per hank on woollen yarn, which, as the average price did not exceed 6s. 6d., was full thirty per cent. on the first cost. It will be seen subsequently, that the woollen manufacture of England were all this time progressively increasing, so that the decline in the imports of wool from Ireland was not occasioned by a declension of trade; the Irish had found other markets for their wool.

From a work entitled “A New Discourse of Trade,” by Sir John Child, supposing to have been published about the year 1667, we learn several important particulars respecting the woollen trade. “Though our vent for fine cloths and stuffs to Turkey, Italy, Spain, and Portugal, were, he says, declined, yet we retained a considerable part, principally because the wool of which our middling coarse cloths are made is our own, and consequently cheaper to us than the Dutch can reel it from us.” In another part he judiciously observes, that the aërs for regulating manufactures, resolve themselves at last into a tax on the commodity, without respect to the goodness of it, as most notoriously appears in the bullions of aulnager, which doublets our predecessors intended for aертониа into the goodness of the cloth; and to that purpose a seal was invented as a signal, that the commodity was made according to the statute; which seal, it is said, may now be bought by thousands, and put upon what the buyers please. Sir John Child admits that wool was eminently the foundation of English riches, and that all possible means should be used to keep it within the realm; but the only efficacious measures to effect it are not penal bullion, but encourage- ment to trade. The impediments at that time he states to be, 1. The high rate of interest; 2. Want of hands, which an act of naturalization would cure; 3d. Compulsion (perfection) in matters of religion. For he adds, “while our neighbours the Dutch have money at lower interest and more hands, by reafon of general liberty of confience, with other free privileges, both to natives and foreigners, there is no question but they will be able to give a better price for our wool than we can afford ourselves, and they that can give the belt price for a commodity shall never fail to have it by one means or another, notwithstanding the opposition.
opposition of any laws by sea or land; of such, force, sub-
tility, and violence, is the general course of trade."

The same enlightened writer appears to have been the
first Englishman who saw the injustice, absurdity, and im-
policy of the numerous restrictions by which the manufac-
turers were obliged to make cloths of certain weights and
lengths, to keep only a certain quantity of looms, or to prohibit dyers, fullerers, &c. from carrying on other
branches of the trade. "It would be (he justly observed)
for the advantage of the trade of England, to leave all men
at liberty to make what cloth and fluffs they please, how
they will, when and where they will, and of any lengths or
sizes."

One of the principal causes of the decay of our woollen
manufactures for Joshua Child might not think it prudent
to state. This was the encouragement given to the con-
sumption of French cloths and woollens in England,
together with the total prohibition of English goods im-
ported into France, or the imposition of duties which
amounted to a prohibition. The French, under the admi-
nistration of Colbert, had been extending and improving
every branch of the woollen manufacture, and were become
our great rivals in foreign markets, as well as at home.
In the year 1678, acts were passed, the 29th and 30th of
Charles II., prohibiting the importation of French com-
modities for three years. From this time trade began gra-
dually to revive, and would have greatly increas'd, had not
political causes operated as a check to our prosperity.

The improvements introduced in the manufacture of fine
cloths by Brewer in 1668, and the more extensive con-
sumption of Spanish wool, enabled us to oppose, with
some success, the rivalry of the French.

After the accession of William, our manufacturers, who
were warmly attached to the cause of religious liberty,
being the greater part Protestant dissenters, were anima-
ted to uncommon exertions in the restoration of their trade. This
is evident from the state of our exports in the following
year after the revolution in 1689, when they amounted
to near seven millions, of which the woollens were nearly
three millions. This is the largest amount till the year
1715. A short time after the revolution, about the close
of the century, our writers on Political Arithmetic, Mr.
King and Dr. Davenant, give the following estimate of
our national wealth, including wool, &c.:

<table>
<thead>
<tr>
<th>Description</th>
<th>Value (£)</th>
</tr>
</thead>
<tbody>
<tr>
<td>The annual income of England, of which the</td>
<td>43,000,000</td>
</tr>
<tr>
<td>people subsist</td>
<td></td>
</tr>
<tr>
<td>Yearly rent of land</td>
<td>10,000,000</td>
</tr>
<tr>
<td>Value of wool yearly shorn</td>
<td>2,000,000</td>
</tr>
<tr>
<td>Woollen manufacture of England</td>
<td>8,000,000</td>
</tr>
<tr>
<td>Woollen manufacture exported</td>
<td>2,000,000</td>
</tr>
</tbody>
</table>

From this period, the woolen trade of England kept
progressively increasing, though subject to some fluctua-
tions. In the following years the amount exported were as under:

<table>
<thead>
<tr>
<th>Year</th>
<th>Value of woollen exports (£)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1718</td>
<td>2,673,696</td>
</tr>
<tr>
<td>1719</td>
<td>2,730,297</td>
</tr>
<tr>
<td>1720</td>
<td>3,059,049</td>
</tr>
<tr>
<td>1721</td>
<td>3,903,310</td>
</tr>
<tr>
<td>1722</td>
<td>3,884,842</td>
</tr>
</tbody>
</table>

About the year 1722, the plague at Marfeilles, by prevent-
ing the exportation of French woollens, increased the de-
mand for English manufactures considerably. In the year
1737, the woolen exports amounted to 4,458,643; and it is remarkable, that at that period the price of wool was
uncommonly low.

The yearly medium value of woolen exports:

- From 1739 to 1748, or to the peace of Aix-
  - In-Chapel, was: £3,327,057
- Yearly medium of woolen exports, from 1749 to
  - 1753, was: £4,189,195

From this time to the period of the American war in
1775, the woollen manufacturors, and particularly the wor-
fted, still continued to increase, with occasional checks. The
quantity of long combing-wools grown in England had
given to the manufacturors of worsted goods a decided ad-
vantage over those of France, though the ingenuity of the
latter in the manufacture of les petites draperies, as the
worsted goods are called, was greatly superior to what our
workmen had ever shewn. The demand for worsted
goods at home, for tammies and fluffs, which were the gen-
eral dress of females before the year 1775, was very great;
besides which, we supplied with worsted goods many of
the southern parts of Europe, and particularly Spain and
Portugal, for the use of their South American colonies, and
for the dress of the clergy, monks, and nuns, which form
no inconsiderable part of the population in those countries.

About the year 1775, the introduction of Arkwright's
inventions for spinning, carding, &c. into the cotton trade,
produced a great change in the article of female dress in
England, fluffs and tammies being supplant'd by cotton goods,
which were become extremely cheap. The failure of the
foreign trade also greatly affected our manufacturors, both
woollens and worsteds. The price of English wool at the
latter end of the American war was lower than it had been
in any period of our history, when money was of much
higher relative value. A tod of 28lbs. of the best Lincoln-
shire wool for combing was not worth more than nine
shillings, and the inferior kinds six shillings, or about three-
pence and four-pence per pound. From the time of
Elizabeth to the middle of the last century, scarcely any
alteration or improvements had taken place in the processes
of manufacture, either in woollen or worsted, beyond the
variation of colours or patterns, to suit the fashion of the
day. The ingenious mechanical inventions of Arkwright,
applied to the spinning and carding of cotton, were soon
after modified, and applied to the woolen and worsted trade,
and produced an entire revolution in some of the feats of
their manufacture. Before that period, the manufacture of
heavy woolens and coarse worsted goods had been gra-
dually concentrating into Yorkshire and Lancashire, where
the cheapness of living, the active industry of the inhab-
itants, and, above all, the cheapness and abundance of coal,
gave the manufacturors a decided advantage over those in
the midland and western counties. The following table,
shewing the amount of broad and narrow cloths made in the
West Riding of Yorkshire, will prove the fact most
decisively. It may be proper to remark, that eighty years
since, about 1738, when our woolen exports exceeded four
millions sterling, the total number of pieces of broad and
narrow cloth made in Yorkshire was only fifty-fix thousand
nine hundred. At present our woolen exports are only
about double what they then were; but the number of
cloths manufactured in Yorkshire is not less than four
hundred and ninety thousand pieces, or eight times more
than the quantity made at the period above referred to.
It must be remarked also, that this account does not in-
clude the cloth manufactured in Lancashire, and the borders
of Cheshire adjoining Yorkshire, nor the blankets, ferges,
baizes, flannels, calimieres, toillins, carpets, rugs, worsted
goods, or any other description of woollens or worsteds,
except plain and narrow broad-cloths. The total amount of
these different woollen articles exceed, we believe, in
weight, if not in value, that of the woollen cloths.
An Account of the Number of Broad Cloths, milled at the several Fulling Mills in the West Riding of the County of York, from the 24th of June, 1725, (the Commencement of the Act,) to the 12th of March, 1726, and thence annually, distinguishing each Year; and of the Narrow Cloths, from the 1st of August, 1737, (the Commencement of the Act,) to the 20th of January, 1738, and thence annually, distinguishing each Year; likewise the Number of Yards in Length, made each Year, from Easter Sessions, 1768.

<table>
<thead>
<tr>
<th>Years</th>
<th>Broads.</th>
<th>Narrows.</th>
<th>Years</th>
<th>Broads.</th>
<th>Narrows.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1726</td>
<td>26671</td>
<td></td>
<td>1772</td>
<td>112370</td>
<td>323591</td>
</tr>
<tr>
<td>1727</td>
<td>28900</td>
<td></td>
<td>1773</td>
<td>120245</td>
<td>363561</td>
</tr>
<tr>
<td>1728</td>
<td>25523½</td>
<td></td>
<td>1774</td>
<td>87201</td>
<td>258730</td>
</tr>
<tr>
<td>1729</td>
<td>20643</td>
<td></td>
<td>1775</td>
<td>95878</td>
<td>284113</td>
</tr>
<tr>
<td>1730</td>
<td>31579½</td>
<td></td>
<td>1776</td>
<td>97933</td>
<td>279539</td>
</tr>
<tr>
<td>1731</td>
<td>35503</td>
<td></td>
<td>1777</td>
<td>107730</td>
<td>315381</td>
</tr>
<tr>
<td>1732</td>
<td>35548½</td>
<td></td>
<td>1778</td>
<td>132506</td>
<td>379990</td>
</tr>
<tr>
<td>1733</td>
<td>34620</td>
<td></td>
<td>1779</td>
<td>110042</td>
<td>342715</td>
</tr>
<tr>
<td>1734</td>
<td>31123</td>
<td></td>
<td>1780</td>
<td>94625</td>
<td>280261</td>
</tr>
<tr>
<td>1735</td>
<td>37144½</td>
<td></td>
<td>1781</td>
<td>102018</td>
<td>309012</td>
</tr>
<tr>
<td>1736</td>
<td>38899</td>
<td></td>
<td>1782</td>
<td>112470</td>
<td>445805</td>
</tr>
<tr>
<td>1737</td>
<td>42956</td>
<td>14495</td>
<td>1783</td>
<td>131092</td>
<td>455336</td>
</tr>
<tr>
<td>1738</td>
<td>44204</td>
<td>58848</td>
<td>1784</td>
<td>138023</td>
<td>409433</td>
</tr>
<tr>
<td>1739</td>
<td>43086½</td>
<td>58620</td>
<td>1785</td>
<td>157275</td>
<td>484085</td>
</tr>
<tr>
<td>1740</td>
<td>41441</td>
<td>61906</td>
<td>1786</td>
<td>158929</td>
<td>493497</td>
</tr>
<tr>
<td>1741</td>
<td>46934</td>
<td>62804</td>
<td>1787</td>
<td>155748</td>
<td>485083</td>
</tr>
<tr>
<td>1742</td>
<td>44954</td>
<td>63545</td>
<td>1788</td>
<td>139046</td>
<td>442432</td>
</tr>
<tr>
<td>1743</td>
<td>45178½</td>
<td>63425</td>
<td>1789</td>
<td>151413</td>
<td>471640</td>
</tr>
<tr>
<td>1744</td>
<td>5467½</td>
<td>68775</td>
<td>1790</td>
<td>172888</td>
<td>515167</td>
</tr>
<tr>
<td>1745</td>
<td>50453</td>
<td>68374</td>
<td>1791</td>
<td>187569</td>
<td>581079</td>
</tr>
<tr>
<td>1746</td>
<td>66537</td>
<td>68080</td>
<td>1792</td>
<td>198351</td>
<td>746072</td>
</tr>
<tr>
<td>1747</td>
<td>62480</td>
<td>68889</td>
<td>1793</td>
<td>190988</td>
<td>605946</td>
</tr>
<tr>
<td>1748</td>
<td>60765</td>
<td>68989</td>
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WOOLLEN MANUFACTURE.

In the table that will be afterwards given, it will be seen that the quantity of yards of different woollen articles exported, which are not included with cloths, greatly exceeds that of broad and narrow cloths. Taking this as a standard, it would appear that the cloth returned at the fulling-mills in the West Riding of Yorkshire is not more than one-third of the total quantity of woollens and worsteds of every description made in the West Riding of Yorkshire, and the borders of Cheshire and Lancashire. Now to make the quantity of broad and narrow cloth given in the returns of the West Riding, would require about one hundred and ten thousand packs; we may therefore state the annual consumption of wool in these districts to be from two hundred and fifty to three hundred thousand packs of 240 pounds each; and we may further state the amount consumed in these districts to exceed that of all the other parts of England and Wales collectively by one-third, including hosiery and all other articles made of wool. This will make the total amount of wool manufactured in England to be nearly what we have before estimated, or five hundred thousand packs.

The number of persons immediately employed in the various branches of the woollen manufacture in England was stated, in the year 1800, to be 1,500,000, and that the trade directly and collaterally employed double the above number. This was asserted in the speech of Mr. Law, now lord Ellenborough, in the house of lords, as council for the petitioners against the export of wool to Ireland. But we apprehend that the statement greatly exceeds the actual number employed in this trade, including their families.

The amount of the population of the West Riding of Yorkshire is nearly ascertained, and perhaps two-thirds of the whole may be engaged in the woollen manufacture, including the families of the persons employed. If we state these to be 340,000, exclusive of the woollen manufacturers in Cheshire and Lancashire, we shall certainly not under-rate them. A large part of the West Riding being agricultural solely, and in the manufacturing districts cutlery, as at Sheffield, and cottons in the more western parts, employ no considerable portion of the people. If then we take 340,000 as the number of persons, with their families, engaged in the woollen trade in the West Riding, exclusive of Lancashire and Cheshire, and if we suppose that they are one-third of the total number of persons employed in the same manufacture in England, it will make the whole rather exceed 1,000,000 of manufacturers, including their families, which we apprehend is not far from the true estimate. We shall, however, give the precise words of Mr. Law’s speech in the house of lords on the above occasion, the object of which, it must be recollected, was to enhance the importance of the woollen manufacture. “In order to give your lordships some idea of its magnitude, I may venture to state, that there are no less than 1,500,000 persons who are immediately concerned in the operative branches of this vast manufacture; and if what Dr. Campbell states in his ‘Political Survey of the Kingdom’ be true, that from the wool-grower to the consumer a piece of broad-cloth passes through 100 different hands, and that there are nearly the same number of hands dependent on the woolen manufacture, though not actually concerned in it, I may assume that the trade directly and collaterally employs double the above number of hands, or 3,000,000. If we estimate the magnitude of this question (the export of wool) according to the number of persons interested in it, it goes to nearly one-third of the entire population of this kingdom, estimating that population at what is generally reckoned, namely between 9 and 12,000,000.” Though the woollen manufactures of England have considerably increased within the last fifty years, we do not apprehend the number of hands employed is greater than before the introduction of mechanical inventions for carding, spinning, and combing. The working up of one pack of wool, particularly of combing-wool, formerly employed a great number of hands, and was divided into small portions, to be spun in the houses of cottagers in remote districts. This afforded employment to the wives and families of labourers who were engaged in agriculture; but so much time was occupied in taking out and collecting in the work, that at the period we refer to, few, if any, of the master manufacturers in Yorkshire consumed more than one pack of wool per week in their trade. At present there are numerous manufacturers in Yorkshire and Lancashire, who consume from twenty to fifty packs of wool per week.

The cotton manufacture, which may be regarded as of recent date, has employed the population that would otherwise have been thrown out of work in the woollen trade since the introduction of machinery, and has prevented any inconvenience of this kind from being felt at present in Yorkshire. We may, however, observe, that many branches of the woollen and worsted trade have been gradually retiring from the south of England, and concentrating in the West Riding of Yorkshire and in Lancashire. These districts were the first to introduce mechanical improvements into the woollen manufacture, and thus gained a decided advantage over the more ancient seats of the woollen trade. For several years afterwards the effects were felt in the manufacturing districts in the west of England, and great distress from want of due employment for the labouring classes was the consequence.

At present all kinds of machinery that have hitherto been applied to wool are extensively employed in the west of England, and the manufacture of superfine cloth is in a flourishing state in the counties of Gloucestershire, Somersetshire, and Wilts, all ancient seats of the clothing trade. The manufacture of broad-cloth in other parts of the south and east of England is not carried on to any great extent. The manufacture of flannels, serge, baizes, &c. though branches of the woollen manufacture, are distinct from the cloth trade, and seldom carried on in the same district.

The export of woolen goods of all kinds from England, in the year 1815, amounted in declared value to ten millions one hundred and ninety-eight thousand pounds. This was rather an extraordinary quantity; and in the following year the exports fell under nine millions, which may be taken as the regular annual amount of woollen exports at present.

The following table gives the amount of different kinds of woollens exported, with their value, and the places to which they were sent in the year 1816; a year in which our foreign trade was considered as in a declining state. It may be worthy of remark, that though our woolen exports scarcely reached eight millions and a half, the amount taken by the United States of America in that year exceeded three millions; a fact which proves the vast importance of the American market to our manufacturers.
WOOLLEN MANUFACTURE.

An Account of the Quantity of Woollen Goods exported from Great Britain, in the year ending the 5th of February, the various Articles,

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<th>Countries to which exported</th>
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<th>Calameres.</th>
<th>Baizes of all Sorts</th>
<th>Flannel</th>
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<td>Quantity</td>
<td>Declared Value</td>
<td>Quantity</td>
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WOOLLEN MANUFACTURE.

of January, 1817, distinguishing the Countries to which exported, and also distinguishing, as far as and their respective Value.

Goods and Yarn exported from Great Britain.

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<th>Stockings, Worsted</th>
<th>Sundry Articles consisting of Hosiery not described, Rugs, Covers, Eids, Tapes, &amp;c.,</th>
<th>Woollens, mixed with Cotton</th>
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Vol. XXXVIII.
WOOLLEN MANUFACTURE.

If we state the amount of woollen goods exported to be about one-third of our own consumption, or from one-third to one-fourth, which is probably more correct, this would make the total value of manufactured woollens to exceed thirty millions annually. Of the woollen goods exported, the quantity consumed on the European continent fearfully exceeds three millions sterling in value, and a great part of that amount given in the preceding account was for army cloth. Hence it appears, that a very small proportion of the general population of Europe is indebted to this country for its woollens, including under the term both woollen and worsted goods. The increased demand for woollens of every description in England arises partly from the increase of population, but more from the increased demand for articles of luxury or convenience. In the middle of the last century, carpets were scarcely to be seen in the country, except in the houses of the nobility; at present every house in England, except those of cottagers and the labouring classes, has carpets spread in some of the rooms. The consumption of worsted yarn in articles of furniture, and in the linings of carriages, and what is called horse millinery, is very great; and to which the people of England are better dressed than they were formerly. We may from all these causes state, that the home consumption of woollens, in proportion to our population, is double that of any other nation in Europe. To prove that we do not over-rate the proportion of woollens consumed at home, it may be sufficient to state, that the West Riding of Yorkshire alone manufactured, in the year 1817, nearly twice as many pieces of cloth as were exported in that year; but few woollen broad cloths are made for exportation in the west of England, the manufacuturers there being principally fine and superfine cloth for home consumption, the value of which per yard on the average is much greater than that of the Yorkshire cloth. In the present state of Europe, we think it an encouraging circumstance to our woollen manufacturers, that a large proportion of their goods are consumed at home, where the demand will remain certain; and again, that the United States of America take so considerable a part of our exports, as from the increasing population of these states, we may expect that the demand will be increasing for many centuries, and will soon exceed what it will be in the power of this country to supply.

In the year 1800, the woollen manufacturers of England were greatly alarmed at the liberty which was intended to be granted, of exporting wool to Ireland, and petitioned parliament against the measure. The grounds on which their alarms resulted, were partly the preference given to the Irish, and partly the supposed facility that would be afforded to smuggling wool to the continent. Several manufacturers and wool-dealers from different parts of the kingdom were examined before the two houses of parliament; but neither in their evidence, nor in the speeches of the learned council, who were heard in support of the petitioners, can we trace any comprehensive or enlightened views of the subject. The objections urged against the export of wool were grounded principally on the practice of former reigns, particularly those of Edward III., and queen Elizabeth: but the facts we conceive were in opposition to the statements; for during the whole of the latter reign, in which our woollen manufactures were in a highly flourishing condition, the export of wool was freely admitted, on the payment of certain duties; and during the reign of Edward III., the prohibition to export wool under heavy penalties was confined to denizens and foreigners, in order to secure a larger amount of duties to the king, the former paying less duty on exports than natives; nor was it till the reign of Charles II. that the export of wool was strictly prohibited. All the former prohibitions were evaded by licences, which were readily granted for money. It is from this reign, therefore, we must date the prohibition to export wool, as forming an established law of the land; and it is not unworthy of remark, that immediately after this period, and to the time of the revolution in 1688, our woollen manufactures were in a very declining state, which proves that they had not derived much benefit from the measure. The policy of admitting the export of wool has been again recently agitated in parliament, and has renewed the alarm of the manufacturers. It is not by precedents drawn from former ages, but solely by the widmam and justice of the measure, as applicable to one present condition, that a question of this kind should be determined. With respect to short or clothing wool, we believe that a permission to export it would not produce the least effect, as we already import these wools from almost every nation in Europe; it is not, therefore, probable, that foreigners would give a better price for them than our own manufacturers can afford. With long combing-wools, the case is somewhat different, as by the acknowledgment of the French themselves, these woools are wanted to mix with and improve their own. We apprehend, however, that as much is exported at present clandestinely in the form of worsted yarn, as the market may require, the free export of cotton yarn giving great facility for evading the penalty, by packing them together. The permission to export wool to Ireland, which was granted in 1800, has not been attended with any one of the fatal effects which our manufacturers anticipated; nor do we apprehend, that permitting the free export of wool under certain duties would be found to injure our own woollen trade.

In taking this view of the subject, which we trust is an impartial one, we readily admit that the permission to export wool, were it granted, would not be attended with any permanent benefit to the landed interest. A small pamphlet on the subject, recently published by John Maitland, Esq., contains the following judicious observations:—"The manufacturer of our native wool claims from government the preservation of it for his use; for by the statute law of the land, he is confined to its sole for the express purpose of working up the wool which grows upon it. This wool cannot, therefore, upon any just or moral principle, be permitted to go out of the country in an unmanufactured state, without allowing the manufacturer to follow it, or without obliging the grower and exporter of it to maintain him and his children." This is so obvious and just, that whenever the export of wool is admitted, we cannot any longer, as at present, prohibit the woollen manufacturers from emigrating and carrying their industry to the bealt market. "The wool," as Mr. Maitland elsewhere observes, "does not on an average compose more than one-sixth part of the value of the animal on which it grows; and the manufacturer, by obtaining this fifth part, at such a moderate rate as may enable him to sell his goods, when manufactured at a reasonable profit, infures to the owner of land a moral certainty of obtaining the full value for the remaining five-sixths, and receiving an ample price also for all the other productions of his ground." The truth of this observation we know to be fully proved in the Yorkshire markets. Whenever there is any considerable depression of the woolen trade, it is always attended with a decreased consumption of animal food, supplied principally from Lincolnshire, and the counties which produce the largest quantity of wool. Should the permission to export wool be attended with any effect in diminishing our own manufactures, the result would be highly injurious to the land-owner, who would then have to find new customers for
WOOLLEN MANUFACTURE.

his general produce, and new associates to share with him the burden of taxation.

The prices of heavy combing-wool in Lincolnshire, Nottinghamshire, or Leicestershire, may be taken as the average price of this kind of wool over the whole kingdom, there being little variation in the value of this wool from different districts. The following table will shew what have been the prices for a great part of the last century:

Price per Tod of Lincolnshire Fleeces, the Tod weighing 28 lbs.

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From the year 1744 to the year 1777, the prices, though occasionally fluctuating, continued much the same as in the preceding years, but we have not the means of ascertaining precisely what they were in each year. The following table will shew the prices of Nottinghamshire and Leicestershire heavy combing-wool, taken from the most authentic source. We consider the value of this wool to have been fully equal to that of Lincolnshire on each year.

Price per Tod of 28 lbs. of Nottinghamshire and Leicestershire heavy Combing-Wools.

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The above were the average prices of the best lots; the inferior ones might range from one to two shillings per tod under the prices here given. It may be observed, that the price of this kind of wool was lower towards the close of the American war, or about the year 1781 and 1782, than in any former or subsequent period of our history, if we take into consideration the relative value of money. At that time, the quantity of wool unfold in the hands of the farmer was nearly equal to three years annual growth; a quantity too large to have been consumed by our manufacturers, had not the introduction of machinery enabled them to work it up with much greater facility than formerly. The average weight of these fleeces may be stated at four or seven pounds each fleece to the tod of 28 pounds. Since the commencement of the present century, the price of this kind of wool, it will be seen from the above table, has been amply sufficient to remunerate the wool-growers; and we confess we are utterly at a loss to discover on what grounds of sound policy or interest they would wish to make any change in the laws respecting the export of wool. With respect to short or clothing woolls, any change in the existing laws would make no alteration whatever in the price; for it is the extreme of prejudice to assert, that our native clothing fleeces are necessary to the foreign manufacturer, either to supply his demand or improve the quality of his own wool. We might with equal justice revive the absurd opinion, so confidently maintained a few years since, that the best Spanish wool would not make cloth without an admixture with that of England.
WOOLLEN-MANUFACTURE.

WOOLLEN Manufacture, Proces of. In an early part of this work, under the article Cloth, we have given a general view of the procefs of cloth-making, furnished by a principal manufacturer in the west of England. In the present article, we shall confine our account chiefly to thofe improvements in the procefses which have fince been introduced, and shall add a description of the machines which were only fequentialy noticed in the article Cloth, and give references to the plates. The procefses of the woollen manufacture may be clasfed under two heads; thofe by which wool is prepared for the weaver, and thofe by which the cloth is finded after it is taken out of the loom. The forting of wool has already been referred to under the article Wool. English wool is fuppofed to be sufficiently cleaned from pitch marks or other extraneous substances by the wool-foter, and left by him in a proper state to commence the procefs of cloth-making. Spanish wool in the bale has generally some part of the pitch employed to mark the fheep diffiilar adhering to it, which muft be carefully cut off. It was till recently the practice to beat the wool with rods, in order to shake out the dust and open the staples; but this is now principally done by an opening machine with long coarse teeth, called a devil, or wool-mill. Spanish wool is frequently foftly presset together in the bag, that it requires to be opened out by beating, to prepare it for the further procefses.

In the west of England, wool is generally foured before it is dyed or carded; but in Yorkshire this is feldom praotifed on wool intended for white cloths, and among the smaller manufacturers who dye their own wool, it is frequently put into the dyeing-vat unfinished; a procefs which injures the brightness of the colours, but which enables the manufacturer to make a greater weight of cloth with the fame quantity of wool. There is also some faving of labour and expence; but this is more than counter-balanced by the increafed quantity of oil per pack required for unfinished wool, which is at leat one-third more than would be neceffary if the wool were foured. In the west of England, where the wool is foured previously to its manufacture, the procefs is carried on with a degree of neatnefs and cleanliness, which form a perfect contrat with the horrid tlench and difgratifying filthines of the woollen factories in Yorkshire. For fine cloths, olive-oil, called Gallipoli, from the part where it was fuppofed to be fent, is principally used; and for the coarfer cloths rape-oil. Where attention to colour is not required in very coarse goods, fifh-oil is sometimes employed; but if the latter remain in the wool or cloth, it turns brown, undergoing a degree of fermentation injurious to the cloth, and which sometimes occasions spontaneous combustion. To leffen the expence of oil for coarse cloths, fome manufacturers in Yorkshire make ufe of a mixture of soap and water with oil, which answer very well in moist weather, if the wool be immediately carded and spun; but if it remain some time unwatched, or the weather be very hot, the mixture evaporates. It has been attempted to work wool without any oil whatever, but without success. The ufe of oil is to cover the furface of the fibres, and enable them to slide eafily over each other in carding or spinning. What we have before faid of the ftructure of the furface of wool or hair, under the article Wool, will fuffice to fhew the advantage that muft refult from oiling. The wool is sprinkled with oil as evenly as poifible. In Yorkshire the proportion on fine wool is about fix gallons per pack, and this is more equally distributed over it by the wool-mill, through which it paffes previous to the procefs called scribbling. This procefs is a kind of coarse carding, and is performed on a machine similar to that ufed for scribbling cotton, but larger, and with coarfer cards, the principle being similar to that of the carding-machine, hereafter to be defcribed. By this engine the longer fibres are broken down, and they are all laid flat and nearly parallel to each other. The wool leaves the roller of the scribbling-mill in one thin undivided sheet, and the more clear, even, and transparent it appears when held between the eye and the light, the more perfeftly has the operation been performed. On the carding-engine, the operation is repeated on finer cards; but instead of leaving the machine in one continued sheet, it is finally divided into separate portions, which by a flated roller are formed into separate round pieces about one inch in diameter, and two feet three inches in length. The fibres are now arranged fo as more eafily to slide over and twit round each other in the next procefs, which is a kind of coarse spinning called fluffing, performed with the fluffing-machine, which will be defcribed. On this machine each of the rolls from the carding-machine are joined together, and drawn out into a loosely-twifted thread, and wound round a spindle, forming what is technically called a fluffing. These fluffings being taken to the spinning jenny, which will also be defcribed, are twifited in an oppofite direftion, and drawn out into threads of yarn of the requisite length. For very fine yarn ufed in flaws, a machine called the mule is fometimes employed, nearly similar to the cotton mule (see Manufacture of Cotton), the fluffing passing through rollers which affift in drawing out the threads smaller and more regular. The yarn is now prepared for winding, fizing, warping, and weaving. (See Cloth.) Since the article Cloth was written, broad-cloth is almof universally woven by one perfon only in a loom, making ufe of the fly-shuttle. (See Weaving.) The next procefs is fourcing and burling, already defcribed under the articles Cloth and Fulling. The cloth is then fent to the fulling-mill; the finer kinds are prepared for fulling by a mixture of foap and water; in coarfe kinds, fuller’s-earth supplies the place of foap. (See Fulling-Mill, and a farther defcription at the end of the article.) The principle on which the felting depends has been defcribed under the article Wool. By the procefs of fulling, the cloth becomes shortened in length and breadth, and the fibres are incorporated and intimately united with each other. In the belt manufactured cloths, this incorporation is fo complete, that the separate threads can scarcely be diftinguifhed, the bottom of the cloth appearing to form one even continuous fubfance. An improvement in this refept has recently been made at Leeds, by spinning the wool much softer and thicker than has ufurpally been the practice, and uniting the threads in the fulling-mill, and then working the fubfance of the cloth down to a requisite degree of thinnes by the gig-mill, hereafter to be defcribed. At the end of the procefs, the face or furface of the cloth is much softer, and greatly superior in appearance to cloth manufactured in the common procefs. A pack of wool of 240 lbs. will make when milled about one hundred and twenty yards of mixed or coloured cloth from fifty to sixty inches in breadth, according to the quality and finenes of the wool. The procefs of rafting, shearing, and preffing, have been mentioned under the article Cloth, and will be more fully defcribed when an account is given of the gig-mill and shearing-machine. The object of these procefses is to cover the thread with a soft pile, consisting of the fibres of the wool, cut down to an even furface over the whole piece.

There are various kinds of woollen goods worked on the fame principle as cloth, and made with both the warp and the weft
WOOLLEN MANUFACTURE.

The weft of carded wool, but which being unmilled, or finifhed in a different manner, receive different names. Blankets are manufactured on the card, but from wool that poftefles a greater length of staple, and which therefore admits of a deeper pile, being raised on the surface. The yarn is fpun thicker, and left as foft as poftible, in order that it may form a full cover or pile. Fine blankets are made much fliuer and heavier than coarse ones; they are both fcored in the mill, but are fearcely sufficient to undergo the fulling procefs. Thick cloths with a long pile, called duffelds, fawmouf, and bear-fkins, are manufactured on the fame principle as blankets, but they are milled much thicker and dyed, and also raised to a deeper pile. Flannels and very light cloths, fuch as Bath coats, are usuallv fpun small, in proportion to the quality of the wool. In weaving plain cloths, the chain or warp is equally divided by the gears, one half of the threads being above and the other half below, and they crofs each other every time the thread of the weft is thrown through by the ftaffe. In weaving kerfeymeres or caffimeres, on the contrary, the warp is unequally divided, to produce what is called the twill, or tweed, (fee Weaving,) one-third being always above and two-thirds below the ftaffe as it paifes. It is owing to this arrangement of the warp, that it forms a fmalting or diagonal rib across the body of the cloth, which is the diftinguifhing character of this kind of woolens. See Draught of Looms.

Caflmeres are ufually fet in the loom from thirty-four to thirty-six inches wide, and milled to twenty-seven inches. Forty pounds of wool from the bag will make rather more than fifty yards of common milled fine caflmeres; the double milled ones make feds in proportion to the degree of milling they receive.

Swadown and toilinets are made with a cotton warp; the weft is woolen or wofted yarn of various colours, according to the patterns required. Woolen cords have also the warp of cotton and the weft of woolen; they are woven and cut precifely in the fame manner as cotton cords. See Fustian.

Serges are made with the warp of wofted and the weft of coarse woolen yarn, and are twilled. These goods have been for a very long time manufactured extensively in Devonshire, and are principally purchased by the East India company for the China trade.

Carpets have wofted warps and woolen wefts. See Carpet and Weaving.

From the moft remote period of the woolen manufacture until the latter end of the fexth century, or about the year 1780, very few, if any, mechanical improvements had been introduced into it. During the whole time the various proceffes were carried on nearly in the fame manner, but with greater or lefs skill, and were employed upon materials more or lefs valuable. The carding and spinning of wool, and the weaving and finishing of cloth, in the early part of the reign of George III., were effected by the fame machines as in the time of Edward III., which probably were fimilar to thofe of the ancient Romans, but more rude in their conftuction. In an art which had feen fo many centuries roll on without any change, it did not appear poftible to the manufacturer that any improvement could be effected; and had not the genius of Hargreaves and Arkwright changed entirely the modes of carding and spinning cotton, the woolen manufacture would probably have remained at this day what it was in the earliest ages of civilized fociety. That it would have been better for general fociety if it had fo remained we readily admit; but after the improved modes of working cotton were discovered, this was impoffible. The spinning Jenny, which was the fame as that employed in the cotton manufacture, but somewhat larger, was introduced into Yorkshire from Lancashire about the year 1780, but did not become general till about three years afterwards.

In the firft jennies, not more than eighteen or twenty threads could be fpun, and the mode of winding the thread upon the spindle was very imperfect. The carding was still effected by the hand, and the flubbing or roving was prepared on the common spinning-wheel. For some time coniderable difficulty was experienced in carding by machinery, particularly in clearing the wool from the card; and a flight change in the conftuction of the machine was found necessary to prepare the wool for the flubbing-billy, of which an account will be given in the defcription of the carding-machine. Soon after this, the carding and spinning of wool and yarn by machinery became general through the manufacturing districts of the Weft Riding of Yorkshire, and large mills were erected, in which the carding and flubbing machines were turned by a water-wheel, and the roving or flubbing performed on the billy. The wool carded at these mills was sent to the smaller manufacturers in the fiate of flubbing, and the farther proceffes of spinning was effected on jennies in their own premises. Before the year 1787, the old proceffes of carding by the hand, and spinning on the wheel, were entirely discontinued in Yorkshire; but it was fome years after before the new proceffes were generally introduced in the weft of England, and thus, as we have before stated, the woolen trade became more concentrated in Yorkshire, where cloths could be manufactured at lefs expence. About this time, machinery began to be applied to the combing and spinning of long combing-wool, to make wofted yarn. See Worfted Spinning.

In confequence of the great increafe of trade in Yorkshire, it was found difficult to obtain situations for mills to be turned by water, and the application of the steam-engine to woollen machinery became very general. The abundance of fuel was highly advantageous to the Yorkshire manufacturer; and it was found to be equally cheap to work the machines by steam as by water, where any conceivable rent was paid for the water. The motion of the improved steam-engine was also rendered as regular as a water-wheel, and the great inconvenience and lefs from the interruption of the works by frofts or continued droughts were thereby avoided.

The smaller manufacturers in Yorkshire were at firft benefited by the introduction of machinery, but in a little time large capitalifts began to engage in the woollen trade, and performing all the proceffes with their own machinery, they were enabled to work cheaper and underfell the smaller makers. The facility also with which wool could now be worked up kept the markets always well stocked with goods, and prevented the manufacturers from taking the advantage of a temporary scarcity or a briff demand, which they had formerly done, an overstocked market always reducing the profits.

Soon after the year 1800, the number of small manufacturers began rapidly to decrease many of them, being ruined by the change which had taken place, and compelled to become workmen in the factories of the large capitalifts.

The gig-mill and the shearing-machine were not introduced into Yorkshire until they had been several years employed in the weft of England, owing to the refiftance made to them by the working cloth-dreflers or croppers in the north.

The manufacture of wofted is properly a branch of the woolen manufacture, and noticed as fuch in our history of its progress in England; yet the mode of manufacture, both in preparing the wofted yarn and finishing the goods, being
WOOLLEN MANUFACTURE.

entirely different from woolens made of carded wool, and part of it being applied to hosiery, we refer, for a further account of it, to the articles Worsted Manufacture, and Worsted Spinning.

Description of the Machines employed in the Woolen Manufacture.—The wool-mill, or swiftly, is the first machine which is employed on the raw wool to open and difentangle the close matting, in which the wool comes from the wool-flaker. It is also used for clearing the dyed wool from the dye stuff, and again for mixing different parcels of wool together; also for incorporating the oil with the wool.

The wool-mill used in Yorkshire consists of a cylindrical drum, about three feet long and two feet and a half diameter, which is made to revolve near three hundred times per minute. Its circumference is furnished with teeth or spikes, and immediately above it four small rollers are placed, which are also furnished with similar teeth. The teeth of the rollers and those of the drum intersect each other when they all turn round; and the teeth of the five small rollers also intersect each other. The cylinder and rollers are inclinced in a box or cafe, which is closed on all sides, except a door in front, which turns down, the hinges being at the lower side. When this door is shut up it stands in a perpendicular plane, very near to the teeth of the drum; when the door is opened, or turned down into the horizontal position, the wool is laid upon it, about one pound weight at once, and the door being closed the wool is brought within reach of the teeth of the cylinder, which take the wool and carry it upwards, so as to work it between the teeth of the cylinder and those of the five rollers placed over it. This effect the opening of the wool, and breaks the fibres if the staple is too long: it also separates the matted fibres. In about three seconds, the pound of wool is generally sufficiently worked, during which time the cylinder has made about fifteen turns. The lower part of the cafe in which the cylinder revolves is a grating of wooden rods, through which the dirt and dust escape. The cylinder is fitted very close to this grating, so that the wool cannot escape from the cylinder, but is carried round in it, and is thus repeatedly submitted to the action between the teeth of the cylinder and those of the rollers. When it is judged that the wool is sufficiently worked, the door is opened again, and the centrifugal force throws out the wool in an instant; a fresh charge is then laid upon the door, and shut up in the machine. A preferable mode is to have two doors on opposite sides of the cafe; one to put in the raw wool, and the other for the finished wool to come out at.

The wool for coarse goods is passed several times through the wool-mill; first, to break the mats of the raw wool and render it light; then a second time after it is dyed; a third time to mix the different sorts together; and lastly, after the wool is oiled, it is passed a fourth time through the wool-mill, with a view to incorporate the oil well with the fibres of the wool.

Scribbling-Machine.—This is the first stage of carding. The operation tends to difentangle the fibres which were before closely entangled, and draw them out separately, so as to render the wool light and thin. The scribbling-machine is very similar to the carding-machine, having a large cylinder or drum, which is covered on the surface with sheaths of leather fluff full of projecting wire-teeth, called card-wires. The teeth are so close together as to cover the whole surface of the cylinder, like the bristles of a brush. This cylinder is turned rapidly round by the machinery, and the wool is regularly and slowly supplied by feeding machinery to its teeth, which take it up, and the cylinder, as it were, clothes itself with wool. This wool is carded or worked by the teeth of several other smaller cylinders, called workers and clearers, which are fixed around the great cylinder in pairs. The teeth of the workers take the wool from the great cylinder, and give it to the clearers, which return it again to the great cylinder. It is then transferred to another worker, and by its clearer is given back to the great cylinder, and so on. It is by the repeated transferring of the wool from one cylinder to another, that the chief action of scribbling or carding is performed. The teeth of the different cylinders do not actually touch each other, but they work it near together, that the fibres of the wool which the teeth of one card contains are caught by the teeth of the other card, and drawn out a very fast at a time. This action tends to separate the fibres, and renders the wool light and open, and also distributes the wool with great evenness over the surfaces of the cylinders. After the wool has passed between three or four pairs of workers and clearers, it is taken up by a cylinder, called the doffer, which is smaller than the great cylinder, and turns round very slowly. The wool is stripped off from this doffer by a fleet comb, which is situated parallel to the axis of the doffer, and is moved rapidly up and down by a crank turned from a small space. In affecing, the comb does not touch the doffer; but when the comb makes its down stroke, it comes in contact with the teeth of the cards, and comb out almost all the wool they contain. As the doffer turns round very slowly, and the comb acts at small intervals, the successive portions of wool which it combs or strips off, hang together in a continued fleece or web of a very thin texture, which hangs down from the doffer, and is received in a basket.

The wool in this state is said to be scribbled, but the fibres are not yet sufficiently combed out or separated; for on examination of the scribbled wool, many small knots and films of wool are found, which are still closely entangled. The scribbling is therefore repeated twice or three times, and then the wool undergoes another operation, which is called carding, but which is very nearly the same as the scribbling, only the wool is formed into small cylindrical rolls, which are the first rudiments of a thread.

We have thought it needless to give a drawing of a scribbling-machine, as it may be readily conceived from the following description of the carding machine.

Carding-Machine. (See Plate IV. Woolen Manufacture.)—A is the wood frame of the machine, but the belt machines have cast-iron frames; C C is the outside of the large cylinder, which is about thirty inches diameter, and twenty-fix inches wide; its axis is supported on bearings at each side of the frame, and it is put in motion by an endless strap applied upon a pulley at one end of its axis, which pulley cannot be seen in the figure. The cylinder revolves about 100 times per minute. B is an arch of wood to receive screws, which support the five small cylinders marked 2 a and 2; these are the workers and clearers. The workers 2 a are larger, and turn slower than the clearers 2; each worker is acted upon by its clearer, and both worker and clearer act against the cards of the great cylinder. The raw wool is spread evenly upon the feeding-cloth 5, at one end of the machine; it is an endless sheet stretched over two rollers, one of which has a cog-wheel G upon the end of its axis, and receives motion from a pinion situated behind the pulley F. This pulley is turned by an endless cord passing round a pulley 8, fixed upon the cog-wheel E, which is turned by a pinion 8 on the end of the axis of the great cylinder. The wool which is spread on the cloth 5 is taken off, between a pair of feeding-rollers, which are clothed with cards laid on in spiral fillets. These rollers cannot be seen, being within the frame; they are about 2 inches
WOOLLEN MANUFACTURE.

Inches diameter, and are turned round by toothed pinions on the axis of the cloth-roller, so as to move rather quicker than the feeding-cloth. The feeding-rolliers give the wool to a cylinder $4\ a$, called the carrier, which is about nine inches diameter. The carrier works against the cylinder $C$; but as its surface moves more slowly than the surface of the cylinder, the wool contained in the teeth of the carrier is taken up by the cylinder. The carding-machine represented in our plate is shewn with a cylinder $3$, beneath the carrier; this is not used in the present machines, but the feeding-rolliers give the wool at once to the carrier $4\ a$.

That part of the cylinder which is adjacent to the carrier moves upwards, so as to carry up the wool it has taken from the carrier, and give it to the workers $2\ a$ and clearers $2$. The surfaces of the workers are fixed in the same direction as the surface of the great cylinder, but they turn slowly, being put in motion by the chain $9$, which paffes over wheels at the ends of all the three workers. These wheels have cogs or teeth to enter into the links of the chain, and prevent it from flipping; the chain paffes beneath a wheel fixed on the axis of the cog-wheel $E$, but within the frame. The wheel $E$ is turned by a pinion $8$, fixed on the extremity of the axis of the great cylinder; and the proportions are such, that the workers $2\ a$ revolve once to about four turns of the great cylinder, and the workers being about $6\frac{1}{2}$ inches diameter, whilst the cylinder is 30 inches diameter, the surface of the cylinder moves about $18\frac{1}{2}$ times as fast as the surfaces of the workers.

The small rollers, called clearers, are placed in as to card the wool on the workers, and on the great cylinder also. The clearers are turned round very quickly, and take the wool from the workers, but their surfaces do not move so fast as the surface of the cylinder. Thus the ftrap $13$ paffes over a wheel of about $83\frac{1}{2}$ inches diameter, fixed on the extremity of the axis of each clearer; this ftrap is put in motion by a wheel of about $22\frac{1}{2}$ inches diameter, fixed on the axis of the great cylinder; therefore, the clearers turn about $24$ times to one of the great cylinder; but as they are only $3\frac{1}{2}$ inches diameter, and the great cylinder is $30$ inches diameter, the surface of the cylinder moves near $3\frac{1}{2}$ times as fast as that of the clearer. The carrier $4\ a$ is turned by the same ftrap $13$; but being larger than the clearers, its surface moves much quicker, so that the cylinder’s surface moves only about once and a half as fast as the carrier’s surface.

The ftrap $13$ also turns a cylinder $2$, at the right-hand end of the machine, called the fly: its surface moves the same way as the surface of the cylinder, but moves nearly once and a half as fast; the pulley at the end of the fly being only $4\frac{1}{2}$ inches diameter, and the fly itself nine inches. The fly is not placed so close to the cylinder as to take the wool away therefrom, but is intended to raise and loosen it in the cards of the cylinder, so that the cylinder beneath it, called the doffer, can take off the wool more readily. This doffer is $14$ inches diameter, and is covered with separate sheets of card-wire, each about $4$ inches wide, leaving vacant spaces between them parallel to the axis of the cylinder. The doffer moves round very slowly, its surface moving only $\frac{7}{8}$ of the velocity of the surface of the cylinder; it is turned by a band from a pulley on the axis of the roller $D$, which we shall next decribe.

The comb which works against the surface of the doffer, and strips off the wool from it, cannot be seen in the drawing. The comb is supported by two upright rods, screwed to it one at each end; the upper ends of these rods are guided by two horizontal levers, and the lower ends are jointed to two small cranks formed on an horizontal axis, which is situated at the lower part of the frame near the ground, and put in rapid motion by a ftrap, from a pulley at the bottom of the frame beneath the great cylinder. This pulley has a smaller one fixed on the extreme end of its axis, and receives its motion from the same ftrap $13$, which turns the clearers. Every revolution of the cranks causes the comb to rise and fall about two inches; and when the comb descends, the teeth on its edge act against the cards, on the surface of the doffer $4$, so as to take out the wool from them. This wool is separated in a continued sheet or film, because the strokes of the comb succeed each other very quickly, and the doffer turns round slowly; but owing to the vacant spaces between the cards on the doffer, this film only continues for a width of about four inches, and is then discontinued until the vacant space on the doffer has passed by the comb, which then acts again to strip off the wool, and so on: hence the wool is drawn off from the machine in a carded state, in small and very delicate films or webs of about 4 inches wide, and 27 or 28 inches long, which is the length of the doffer.

These detached portions of wool are next rolled up fo as to form small cylindrical rolls, which is done by what is called the roller-bowl $D$ : it is a cylinder of wood, with shallow flutes upon its surface, parallel to its axis; it is turned round slowly by a pulley $H$ on the end of its axis, and an endless band, $14$, which paffes round a pulley $I$, fixed on the wheel $E$. The lower part of the roller-bowl, $D$, is inclosed within a hollow cylinder of wood, called the shell; it encompasses the lower half, being fixed beneath the revolving cylinder; the shell is flattened within the two. The portions of wool, as they are stripped or combed off from the doffer, fall down over the edge of the shell, which for that purpose is situated close to the doffer, at that part of its circumference where the comb works: by this means, the wool which is stripped off falls down into the space between the shell and the roller-bowl; and when the portion of wool is completely detached and drops off, the motion of the bowl within its shell rolls the wool between them with a rolling motion, which forms the wool into a very round and straight cylindrical roll, called a carding, when these cardings drop out from between the roller-bowl and its shell; they fall upon a flat table, $a\ a$, as shewn at 7 7 7. This table is covered with an endless cloth, which is stratched over two horizontal rollers; one of these rollers has a crowf, marked 16, 16, fixed on the end of its axis; the arms of the crofes are feized by a cranked lever, 15, which is fixed to the axis of the roller-bowl, and at every revolution the crofs 16 is turned round one-fourth: this moves the endless cloth forwards, and carries the cardings away in the manner shewn at 7 7 7, as fast as they drop out from the shell, and from this table they are carried away to the flubbing-machine, or billy.

In most modern machines the latter movement is altered, the endless cloth being kept in a continual and slow motion by an endless band paffing round a small pulley fixed to the pulley $H$, and a larger pulley fixed in place of the crofs 16. In some old carding-engines many of the motions were performed by toothed wheels and pinions; but of late years all the parts are moved by bands or strips, which produce a much more equable and steady movement. The large cylinders are generally made by placing two or more wheels of cast iron on one axle, the circumference of the wheels being cafed with wood, which is attached to them by screws or rivets. The smaller rollers are formed in a similar manner on wooden disks, but all are made hollow, to avoid warping, which would render the action of the cards irregular and uncertain.

We
WOOLLEN MANUFACTURE.

We must now return to the carding-machine; it is the same as the carding-machine, except that the breadth of the cylinder is greater, and the teeth are coarser; there is no roller-bowl D, and the doffer 4 is completely covered with cards, without any breaks or intervals; hence the film of wool which is taken off is continuous, and is suffered to fall down into a basket.

Double Scribbler.—In Yorkshire it is common to employ double scribbler{s}; that is, two of the machines combined together, and placed in one frame; there are two large cylinders, each surrounded with its workers and cleaners, and doffer, as we have described, making in all seventeen small cylinders. The first great cylinder has a feeding-cloth and carrier, to supply the wool to the cylinder; but the second large cylinder is supplied with wool from the doffer of the first cylinder, which doffer serves in place of a carrier to the second; it therefore has no comb. The doffer of the second cylinder has a comb to take off the wool, which then falls into a basket.

This machine is said to save trouble of attendance, and does more work than two single machines. The usual practice is to pass the wool once through the double machine, and then once through a single machine. A double machine will scribble about a hundred weight of wool per day.

After the wool is scribbled it is weighed, and when it is taken to the carding-machine, a certain weight is spread over a certain length of the feeding-cloth, so as to supply the wool to the machine with perfect regularity. The proper weight which should be allowed is ascertained experimentally, according to the fineness of the thread which is required to be spun. The cards are weighed from time to time, to ascertain if each one contains the proper quantity of wool.

The cardings produced by the united operations of scribbling and carding are composed of fibres of wool laid very lightly together with the leaf possible entanglement; they are very regular and even in size, and upon this circumstance the perfection of the spinning chiefly depends.

Scribbling-Machine, or Billy.—This performs the first process of spinning. It reduces the cardings, and draws them out in length; joins them together, and gives them a slight twist, in order to form a coarse and loose thread, called a scribbing or roving, which must be spun over again in the Jenny, to make a thread fine enough for the loom.

This operation was formerly performed by hand on the common hand spinning-wheel, which is similar to that used for spun wool, but of a smaller size. Machines were then contrived by which a number of scribbings could be drawn out together; but the aid of the hands was required for joining the rolls or cardings of wool together in succession, and for other purposes, which were found to take so much time, that very little, if any, saving of labour was effected by the use of such machines.

A perspective view of the scribbling-machine, now universally employed, is given in Plate 1. Woolen Manufacture. A A is the wood frame of the machine; within this frame is a moveable carriage D D, which runs upon the lower side rails at a, with wheels 1, 2, to make it move easily; and it is capable of running backwards and forwards in the frame from one end to the other. The carriage contains a number of perpendicular spindles, marked 3, 3, which are put in rapid motion by a long cylinder F, and a separate band from each spindle, which passes round a small pulley on the spindle. The cylinder F extends horizontally across the whole breadth of the carriage; it is made of tin plate, hollow like a tube, and covered with paper on the outside.

The spindles are placed in a frame, as to hand nearly perpendicular, at about four inches from each other; their lower extremities are sharp-pointed, and turn in sockets, and they are retained in their perpendicular position by a small collar of brass for each, which surrounds the spindle at about the middle of its length. The upper half of each spindle projects above the frame, and on the lower part of the small pulley or whirl is fixed, to receive the bands from the horizontal cylinder, which is about six inches in diameter, and a little longer than the rows of spindles; it is placed before them with its centre at a lower position than the rows of whirls. The cylinder receives motion by a pulley at one end, with an endless band from a wheel E, made like the large wheel used in spinning wool by hand, and of the same diameter. The wheel is situated at the outside of the great frame of the machine, and its axis is supported by up-right standards secured from the carriage D; the wheel is turned by the left-hand of the spinner, applied to a watch, which is plainly seen in the drawing, and gives motion to the cylinder F, which again turns all the spindles at once with a great velocity.

Each spindle receives a thread, or flubbings, which threads issue from beneath a roller, C C, at one end of the frame, and proceed to the rows of spindles placed in the carriage, so that the flubbings are extended nearly in a horizontal direction. Th. spindles, by the motion of the carriage, are capable of advancing or retracting from the roller C, so as to extend any required length of flubbing.

The cardings of wool, which are to be spun into flubbings, are extended side by side up an endless cloth, which is framed in an inclined position between two horizontal rollers, one marked B B, and the other cannot be seen. There is one carding for each spindle, and the number is usually from 50 to 80. C is a light wooden roller to bear upon the cardings which lie upon the cloth, and press slightly upon them by its weight. Immediately before this roller is a wooden rail G, and another beneath it, which is fixed horizontally across the frame: the cardings are conducted between these two rails, the upper of which is capable of raising: but when it falls by its weight, it holds the cardings fall between the two, and hence these rails are called the clasp; the upper moveable rail G of the clasp is guided between slivers and a wire J descends from it to the lever 6. When the carriage D is wheeled close home to the end of the machine, a wheel 7 lifts up the end 6 of the lever; and this, by the wire J, raises the upper rail G so as to open the clasp, and release all the cardings: in this state, if the carriage is wheeled or withdrawn back from the clasp, it will draw the cardings forward. There is a small catch which receives the upper rail G of the clasp, and bears it up from falling until the carriage has retraced a certain distance, and drawn out about eight inches length of the cardings; a flap on the carriage then comes against the catch and withdraws it; the upper rail of the clasp G then falls and holds the cardings fast, whilst the carriage continues to recede, and draw out or stretch that portion of each carding which is between the clasp and the spindle. All this time the wheel is turned to keep the spindles in motion, and give twist to the cardings in proportion as they are drawn out, by which means it is prevented from breaking; because as the carding diminishes in size, and increases in length, the increasing twist combines the fibres of the wool, so as to give tension to the coarse thread or flubbing which is thus produced.

The flubbing is lapped round the spindle, but the clasp being higher than the upper ends of the spindles, the direction of the flubbing is not quite at right angles to the spindle: hence the spindle, when it is turned round, will give twist to the flubbing, without winding or gathering it up.
up upon the spindle, because the flubbing always slips over the top-end of the spindle; but when a portion of each flubbing is finished, and it is required to wind it up round the spindle in a ball, the flubbing must be preeled down by a wire 8, so as to bear it from the point of the spindle, and place it opposite to the middle part of the cop or ball upon the spindle, and then the motion of the spindle will cause it to wind up upon the spindle, and form a ball.

The wire 8 is made to operate upon the whole row of flubbings at once, and for this purpose a horizontal rail 4 is placed in the front of the row of spindles, being provided with pivots at its extreme ends, on which it is supported in standards rising from the carriage D. It has a small arm or lever projecting from it at each end, and the wire 8 is fretted between these arms. By turning the rail 4 round upon its pivots, the wire is capable of being raised up, as in the figure, or lowered down at pleasure: when the wire is lowered, it depends below the level of the top of the spindles, so as to bear down the threads which, when the wire is raised up, as shown in the figure, proceed from the points of the spindles.

The spinner holds the rail 4 in his right-hand, and it is by this that he draws the carriage either in or out, according as it may require; and by turning the rail 4 round, he can elevate or depress the wire 8, so as to make it bear down the flubbings to any degree at pleasure; by this means, he distributes the flubbings upon the spindles in a proper manner, to form a regular ball or cop, as shown in the figure.

As the cardings are very light and tender, they would be liable to break if they were dragged forwards on the inclined cloth, or even if the cloth were to be moved round its ролler by the force applied to the cardings. To avoid this, a cord is applied round a groove in the middle part of the upper roller, and after passing over proper pulleys, as shown in the drawing, it has a weight suspended to one end, and a smaller weight to the other; the small weight is only to keep the rope tight, but the large weight tends to turn the rollers and endless cloth round in a direction to deliver out the cardings, so that there will be no strain on them.

Every time that the carriage is wheeled home, the large weight is wound up by means of a piece of wood projecting from the carriage, which fixes a knot in the cord at the part which lies horizontally; this pulls the cord back a certain distance, so as to draw up the great weight; but the endless cloth cannot turn backwards, because there is a ratchet and click at one end of the roller which prevents it; the rope, therefore, slips round upon the roller. When the carriage retires, the great weight turns the roller and endless cloth round, so as to deliver out the cardings at the same rate as the carriage retreats and takes them up; but when the proper quantity is given out, the knot in the rope arrives at a fixed knot, which does not permit it to move any farther; and at the same instant the roller 5 quits the lever 6, and allows the upper rail G of the clamp to fall, and hold the clamping fault from being drawn out any farther; the wheel E is then put in motion to turn the spindles round, and the carriage is drawn back, which extends the flubbings, and twirls them at the same time, as before mentioned.

When the carriage is drawn out to its full extent, and the necessary twist is given, the wire 8 is put down to bear down the flubbing from the point of the spindle, and the motion of the wheel being continued, the flubbings are wound upon the spindle in a ball form to form upon the spindle; but as fast as the flubbings are wound up, the spinner must push back the carriage towards the clamp; and he must turn the wheel round at such a rate that the spindles will not wind up any faster than the carriage returns, otherwise the flubbings would be broken or unequally stretched; he must also raise and lower the wire 8 continually, in order to distribute the flubbing on the cop in a regular manner, so as to make a firm ball or cop.

A child attends the machine to bring the cardings from the carding-machine, and place them upon the inclined cloth; and when they are exhausted, fresh ones are joined on, so as to keep the machine constantly supplied.

The degree of twist which is given to the flubbing is regulated by the deflection of the spinner in turning the wheel at a proper rate, corresponding to the quickness with which he draws out the carriage. Flubbings which are intended to be spun into yarn for the warp of the cloth require to be more twilled than the flubbings intended for the weft; but the proper quantity of twist depends on the fineness of the wool, and the length of its fibres. In general it may be flated, that no more twist is given to the flubbings than is necessary to make them draw out to the required extent without breaking. This twist is of no use to the yarn, because the flubbing will be twilled in the contrary direction, when it is spun the second time in the jenny.

An improved flubbing-machine has been introduced, which is put in motion by the mill, and the carriage is made to draw out by the power of the machine. The spinner has only to push the carriage in, and turn the handle, in order to wind up the flubbings; by this means, a greater degree of regularity is attained in the quantity of twist which is given to the flubbings when they are drawn out. The movements to effect this are taken from the mule used in cotton-spinning. See Manufacture of Cotton.

Spinning Jenny.—In this machine, the flubbings are spun over again, and reduced to the requisite fineness for weaving. The jenny has nearly the same parts as the billy, but differently arranged. The spindles are placed at one end of the frame, and the clamp which holds the flubbings is placed on the carriage, so that it can be moved backwards and forwards, to and from the spindles by the spinner, in order to draw out and extend the yarn at the same time it is twilled.

A perspective view of the jenny is given in Plate II.

WeLLEN Manufacture.

The spindles 3, 3, 3, are placed perpendicularly at about four inches asunder at one end of the frame A A of the machine. The lower extremities of the spindles are pointed, and turn in small cups or sockets in a cross-rail of the frame; they are supported near the middle of their length by passing through braid-collars in a horizontal rail. Near the lower end of each spindle a small pulley is fixed, to receive an endless band, which passes round the horizontal cylinder or roller 2, about six inches diameter. The cylinder is supported on pivots at its ends in the sides of the frame; and lying in a direction parallel to the row of spindles, it turns them all round by a small band for each. This cylinder is usually made of tin-plate, that it may not alter its figure by the weather, as wood would do; and its surface is covered with coarse brown paper, to prevent the bands from slipping upon it. The cylinder 2 is put in motion by a flap or band 1, 1, which passes round a pulley at the end of it, and also round the great wheel B B, which is supported in a framing suspended over the machine from the ceiling, but which is not shown in the drawing. The wheel B is turned by applying the right-hand to the wheel B. In front of the row of spindles, and about a foot higher than their points, a long cross-rail 16 is situated horizontally: it is supported at each extremity by being mortised into blocks of wood c c, which are furnished

Vol. XXXVIII.
woollen manufacture.

with small wheels or sailors, forming a fort of carriage, to run horizontally upon the side-beams of the main-frame in grooves, which guide them, so that the rail 16 can be moved backwards and forwards through a space of about six or seven feet, in a horizontal position, without varying from its parallelism with the row of spindles. the under-fide of the rail 16 is formed into a number of narrow notches for the flubbings to pass through; and these notches are partly filled up by projecting pieces, rising up from a second cross-rail 5, 5, so as to form the clamp which confines or pinches the flubbings in the notches when the lower rail is raised up; but the flubbings can draw freely through the notches when the lower rail is let down. this lower rail is guided and limited, to move up and down only a small space by flaps, which project downwards from the rail 16, and receive the ends of the lower rail 9 of the clamp. the rising and falling of the lower rail is effected by small cords fastened to it at about every yard of its length; these cords are conducted over small pulleys (concealed in the substance of the upper rail 16), and are all attached to a handle, situated over the middle of the upper rail at 16, and beneath an arched bar, which is fixed on the top of the clamp. the spinner holds this handle in the left-hand, whilst the right is employed in turning the wheel; and by the fingers of the left-hand the can raise up the lower rail 9 of the clamp, and draw it close to the upper one. it will then be retained in that position by a small spring-catch, and will clamp the flubbings fast in the notches, through which they pass; but when the spring-catch is pushed back, so as to relieve the handle, the lower rail will fall down by its own weight, and release the flubbings, to allow them to slide through the notches.

the cops of flubbings which are to be spun are supported in an inclined frame 4, 4, fastened within the main frame of the machine. the cops are mounted upon iron wires; they are placed in two rows, one above the other, as shown in the drawing; but each row should only contain half as many cops as are there spindles.

each flubbing is conducted through a notch in the clamp, and thence it proceeds nearly in an horizontal position to the spindles 3, 3.

when the yarns have been drawn out and twisted they are wound up on the spindles in balls, in a similar manner to the billy. the wire which is used for bearing down the thread from the points of the spindles is marked 12; it is attached to a horizontal rail, which is supported on pivots at its ends, close to the row of spindles. there is a small pulley 11, fixed at one end of the rail, and a short lever at the other, which lever is hidden in the drawing by a part of the framing. between the pulley 11 and the lever, the wire 12 is extended, and by turning the rail round upon its pivots, the wire will have a motion up or down.

the spinner can communicate motion to the pulley 11 by means of a cord 7, 7, which passes round it, and extends the whole length of the frame, the end being made fast to a pin at a; this cord lies over the surface of one of the blocks 6, which contains the wheels of the carriage, and passes between the small pulleys 9, 9, and 8. the centre pins of the pulleys 9 and 8 are fixed to the block 4, but the centre pin of the pulley 6 is fixed to a small slider, and can be drawn in the direction of the rail 16, by applying the finger to a small trigger near the handle 16. this action removes the pulley 6 out of the line of the other two pulleys, so as to shorten the cord 7, and turn round the pulley 11; this brings down the wire 12, and bears down the threads upon the spindles. a small counter-weight is suspended from the wheel 11, to return the wire to its former position when the preffure of the finger on the trigger is removed. by

this movement, the spinner has full command of the wire 12, to raise or lower it in any degree he thinks proper; and this is done independently of the motion of the carriage, because the pulleys 9, 9, and 8, run freely along the cord 7, and their motion has no tendency to move the wheel 11 either way.

the jenny is worked by one person, who stands within the frame, and turns the wheel b with the right-hand, whilst he holds the clamp in the left, so as to run it backwards and forwards along the frame at pleasure. the flubbings are drawn between the moveable rails 16 and 5, in the notches of the clamp, and each flubbing is fastened on to its corresponding spindle. the clamp being left open is drawn backwards from the spindles, and the flubbings run freely through the notches of the clamp; the flubbings are drawn off the balls at 4, when the clamp retires from the spindles, until a certain length of each flubbing is drawn out and extended nearly in an horizontal position between the spindles and the clamp; this length is regulated by a mark made on the frame of the machine, to indicate when the clamp has arrived at its proper position. the bars of the clamp are then brought together by raising up the handle under the catch, as before described, and it fastens all the flubbings in the notches. this being done, the spindles are put in rapid motion by turning round the large wheel b; they twist those parts of the flubbings which are extended, and the motion being in a contrary direction to the twist of the flubbing, the first tendency is to untwist the flubbing, at the same time that the carriage and clamp are gently drawn back, or from the spindles. by this means, the flubbings are fretted or drawn out in length at the same time that they get a new twist in the opposite direction; this keeps them from breaking, and when they are drawn to their intended extent by the carriage being moved back to the stops at the extremity of the main frame, the great wheel is turned round as many turns as is necessary to give them all the twist which those portions of thread are intended to have.

the threads extended between the clamp and the spindles are now finished, and it only remains to wind them up upon the spindles, previously to drawing out a fresh portion of each flubbing, in order to spin it in the same manner. to wind up the threads, they are pulled down upon their respective spindles, by pressing the trigger which moves the wire 12; and the motion of the great wheel b is continued, in order to wind up the flubbings in balls upon the spindles, at the same time that the carriage and clamp are pushed back towards the spindles. when the carriage is got home, the thread is finished and wound up, and a fresh portion of flubbing is extended. to do this, the lower rail of the clamp is dropped down, and it releases the flubbings; the carriage is then drawn back to the mark upon the frame, as before described, which shows that a proper length of each flubbing is drawn off from the balls, and extended between the spindles and the clamp. the clamp is then closed, and the wheel b put in motion to twist the threads whilst the carriage is drawn out; thus the spinning operation is repeated as before, and prepares another length of each of the threads. when finished, they are pulled down from the points of the spindles, in order to make them wind up therein in the balls, as before.

there is some discretion required in spinning with the jenny, to draw out the carriage with a movement correspondent to the rapidity with which the spindles give the twist, or rather untwist, to the flubbing; for the principal extension of the thread is effected whilst the flubbing is untwisting, and whilst the first portion of twist is given to the threads. these motions must be properly proportioned by
the spinner, who must also be careful to give an equal degree of twist to each successive portion of thread which is spun, otherwise the thread will consist of hard and soft places.

When the yarn is intended for the warp of the cloth, the spindles are turned for a given time after the thread is extended to its full length, as we have before mentioned; but for the yarn which is to be used as weft, it is different: the whole of the twist is given during the extension of the thread, and none afterwards; this difference is to render the weft lofter than the warp, because in the cloth the weft appears more on the surfaces than the warp, and it is principally the felting and interlacing of the fibres of the weft that will form the surface of the cloth when finished.

The yarns are usually extended in the jenny two and a half or three times the length of the flubbings from which they are spun; and that degree of twist given to them which is suitable to the purpose for which the yarn is to be employed.

The Mule for spinning Yarn is very nearly the same machine as the mule for spinning cotton; this is used for spinning some kinds of woollen yarn instead of the jenny. When the mule is employed for spinning yarn for weft, it is used in the same manner as described in our article COTTON MANUFACTURE; but for spinning warp, the spindles are made to revolve, and twist the thread some time after the carriage is run completely out, and the stretching of the yarn is finished. There is a movement in the machine that shifts the endless strap which turns the mule upon a larger pulley, as soon as the carriage is run fully out, so as to give a more rapid motion to the spindles after the stretching, or drawing out, is finished, than they had during the drawing back of the carriage. By this means some time is saved, because the spindles may be allowed to run very quick when it is only required to twist the threads; but whilst the extension is going on, the twisting motion must be moderate, or the threads would be broken. A very similar movement is used in the mule for spinning cotton, and is called the double-speed; but the description of this mechanism is omitted in the article MANUFACTURE.

The mule has not, till lately, been in much repute for spinning woollen yarn, and the jenny is still thought to spin better yarn: but we have no doubt that when certain modifications are made, it will become a much more perfect method than the jenny, being much less dependent on the discretion and dexterity of the spinner; for if the machine is once constructed so as to spin properly, it will always continue to do so.

To keep the yarn to the size which is intended, a few of the coppins are reeled off, in order to measure out a certain length of the yarn, which is weighed; and if it does not prove of the weight expected, the quantity of wool which is spread over a given surface of the feeding-cloth of the carding-machine must be increased or diminished accordingly; and when the right quantity is formed, the lead weights which are used for weighing the given quantity of wool are altered to suit it. The draft of the jenny may also be altered to effect the same thing.

The spinning processes are now finished, and it remains to weave the yarns into cloth. From the description we have given, it will appear that woollen yarn is spun in a very different manner from cotton. The opening processes and the scribbling and carding are very similar, except that the carded wool, instead of being drawn into a continued sliver like cotton, with the fibres stretched the lengthways of the sliver, is formed into separate rolls, with the fibres disposed crosswise or spirally round the roll.

By the fluffing-machine these are joined together, drawn out in length, and slightly twisted, by operations similar to that of roving in cotton-spinning; but the operation of drawing, which is so frequently repeated for cotton, would be useless, and to a certain extent even prejudicial for wool. The object of that process is to elongate and stretch the fibres of the cotton straight, and lay them parallel to each other; but it does not reduce the sliver to a smaller size, because as many times as the sliver is extended in length, so many fibres are put together into the drawing-frame at once, leaving the sliver which has been drawn the same size as it was before, but elongated to three or four times the length, and all its fibres fully extended.

As woollen cloth is intended for felting, it is not desirable to straighten the fibres, but only to disentangle all knots, and unfold any fibres which may be doubled, also to lay the fibres in the direction of the length of the thread. There is a natural curl in the fibres of wool which should be preferred, and will contribute to the firmness with which the fibres will entangle in the felting.

The operation of spinning by the jenny and billy are very similar, but both differ from the manner in which the extension is made in the cotton spinning-machines by rollers. In the jenny, the extension is made upon a considerable length of the carding or fluffing at once; but in the rollers, the length of cotton which is submitted to the action of drawing out is very short, indeed very little longer than the length of the fibres of the cotton. In mule spinning both modes of extension are practised; first, drawing the roving by rollers, and then a certain length is stretched out to a greater extent.

Warping.—The coppins of yarn are mounted on wires in a frame, and the yarns are drawn off from them, in order to combine a sufficient number of them together, to form the warp for the web of cloth which it is intended to weave. For instance, for making the cloth called double drab, which we shall take as an example, 2060 threads, each 65 yards long, are laid parallel to each other; but a separation is preferred at every 40 threads, dividing the whole into 74 parcels, for the convenience of the weaver.

The warping is performed by the warping-mill, which is a large reel, with its axis horizontal; the ends of the threads are made fast to the reel, which is turned round, and it draws the threads off the coppins, so as to wind them upon its circumference; and to prevent the different turns of the threads from lying one over another, the threads are guided through an eye or ring affixed to a slider, which is moved along a wooden rail, in a direction parallel to the axis of the reel, by a cord that winds round one end of the axis of the reel. A warping-mill for silks is described in our article SILK, and will give a clear idea of the present, which only differs in the horizontal position of the axis, and in the greatness of its dimensions. The threads for the warp being thus assembled together, are taken off the reel, and rolled up into a bundle.

The warp is then soaked in urine, to remove the greasiness of the wool, and is next sized; to do this, it is dipped into the cauldron of size, about ten yards in length at a time, and well worked in by the hands. After sizing, the yarns are stretched out at length in a field, till they are dry, and the warp is then ready for the loom.

The yarn for the weft is wound off from the cops of the jenny to the quills or small bobbins, which are to be put into the shuttle.

The loom for weaving broad-cloth has the same parts as the simple loom described in our article WEAVING; but it is made very strong, to enable it to resist the strain of weaving such
WOOLLEN MANUFACTURE.

The fly-shuttle, invented by John Kay in 1737, is now in general use; it enables one weaver to do the work, which formerly employed two men at opposite sides of the piece, to throw the shuttle from one to the other, the width being greater than a man can reach. The warp is wound on the yarn-beam, which is placed in the loom, and the threads being drawn through the bobbins and the reed, fastened to the cloth-beam, the loom is ready for working, in the usual manner of weaving plain cloth. At each edge of the warp a few threads of strong and coarse yarn are placed; these form what are called the lifts when the cloth is woven, and serve to give strength to the cloth, and receive the hooks by which the piece is stretched in the tenters after milling.

The width of the cloth is measured between the lifts and the number of yarns, which we have specified will make 100 inches in width for the double drab-cloth, or for common cloth 3000 threads will make a piece 105½ inches wide. The quantity of wool used for these cloths is upon an average one pound weight to a yard in length. The length of the warp contracts a little in the weaving, so that the sixty-five yards of yarns will make only sixty-two yards of cloth.

Scouring.—The piece of cloth must be cleansed from the grease of the oil before it can be felted; for this purpose, it is first soaked three hours in a mixture of urine and pig's dung, it is then scoured in the mill for two hours, and lastly, for half an hour with fair water. The scouring is performed at the fulling-mill by a pair of flocks. (See Fulling-Mill.) The pair of flocks are two large wooden hammers, suspended with the helves or handles in an inclined position, and the heads are lifted in succession by cogs or tappets, fixed on the axis of a water-wheel. When the coggs quit the hammers, they fall by their own weight, and strike the piece of cloth, which is contained in a wooden cittern or trough, in which the hammers work. The action of the hammers is to beat and compress the folds of cloth, and to turn the piece continually round in the trough or cittern in which it is placed. The form of the trough is such that the weight of the piece of cloth causes it to occupy the lower part of the trough, and each hammer when it descends drives the cloth out from this lowest part, and forces it up a curved sweep. When the hammer is lifted up, the cloth falls again into the space which it before occupied, and at the subsequent descent of the hammer it is again driven out; the head of cloth is of a considerable bulk, and this action of the hammers is chiefly on the lower part of the cloth; the beaks of the hammers strike nearly horizontally under it, as it were to undermine the head, so that the top part falls over when the hammers retreat. This action causes a continual circulation or turning round of the piece of cloth within the trough, and effects the scouring, by continually bending and folding the cloth in a fresh direction; and as the strokes act upon a great number of folds at once, the different surfaces of the cloth are caused to rub against each other, with a very similar action to washing cloth by hand.

When the scouring is finisht, the piece of cloth is taken out, and extended in a vertical plane, in a frame called the tenter, where it remains till dry.

The tenter consists of a number of vertical posts fixed in the ground with a continuous horizontal rail, which is fixed on the top of them, and is as long as the piece of cloth; there is also another line of horizontal rails, which are fitted between the upright posts, so as to slide freely up and down; and they can be fixed at any distance beneath the upper rails by means of pins in the posts, according to the width of the piece of cloth. Both the upper and lower horizontal rails are driven full of tenter-hooks, which are small iron hooks sharpened at both ends, and bent at right angles, like an L; on these hooks the lifts of the cloth are fastened, and the lower or moveable rails are fixed at the proper distances beneath the upper rails, in order to extend the cloth to its full width.

Burling.—The cloth being dried is burled, that is, examined minutely in every part, and all knots and uneven threads or flaws, or extraneous matters, removed; any rents or defects which can be found are repaired, by introducing fresh threads. This being done before the milling or feltling, the fibres of the new threads will become so entangled as to render such defects nearly imperceptible in the finished cloth.

Fulling-Mill for Felting the Cloth.—There is another kind of flocks in a fulling-mill; but the shape of the trough in which the flocks or hammers work on the cloth is different from that described in the article Fulling-Mill, which is only proper for scouring. In order to subject the cloth to the blows of the hammers, the trough for milling is formed in such a manner that the cloth cannot escape from them, because that part of the trough which is opposed to the beaks of the hammers is nearly a flat surface, and perpendicular to the direction in which the hammers strike, so that the cloth is actually beaten between the beaks of the hammers and the flat bottom or rather side of the trough.

The hammers are made to strike very heavy blows; but they do not bruise or injure the cloth, because there is always a great number of folds of cloth on which they strike. The helves or handles of the hammers are placed in a different position from the scouring-flocks, in order to make the hammer-heads fall in a more perpendicular direction when they make their stroke, and hence they strike with more force. On this account they are called fulling-flocks, whilst those used for scouring are called hanging-flocks, in which the helves of the hammers being nearer to the perpendicular, the heads move in a more horizontal direction, in the manner of a pendulum, and exert less force on the cloth; the other difference is, that the hammers of the fulling-flocks only drive the heap of cloth round in the trough, there being no part directly opposed to the beaks of the hammers but a fair curve, which is so much inclined to the direction in which the hammers move, that the cloth mounts up the inclined curve when the hammer strikes, and evades the direct force of the blow.

There is another kind of fulling-flocks, in which the trough and hammer are constructed with a view to mill or felt the cloth; but the hammers are put in motion in a different manner: thus the helves are suspended in a vertical position, like pendulums, and the force of the cogs on the horizontal shaft, which is turned by the water-wheel, is applied to drive the hammers forwards against the cloth, and produce the felting. To return or draw back the hammers, a chain is attached to each, and these chains are linked to the opposite ends of an horizontal lever, like a scale-beam, which is fixed in front of the flocks. This lever and chains draw back one hammer when the other is pushed forwards; and as the hammers are actuated alternately by the cogs, a constant action is kept up.

The simplest fulling-mill by a water-wheel has no other wheels, but the tappets or cogs which lift the hammers are fixed immediately into the axis of the water-wheel, and it usually gives motion to two pairs, one at each side of the wheel. It rarely happens that this construction of a mill allows the water to be used to the greatest advantage, because the circumference of a water-wheel should not move with a greater velocity than between 180 and 240 feet per minute.
WOOLEN MANUFACTURE.

minute; and the hammers of a fulling-mill should be so timed, that each one will make from about 30 to 36 blows per minute. This requires that the cogs for the hammers should be numerous, and fixed in the circumference of a large wheel, on the side of the water-wheel, otherwise the water-wheel must be made to turn so quickly as to lose a great part of its force. A better way is to apply a cog-wheel on the axis of the water-wheel to turn a pinion on the horizontal shaft, which carries the cogs for the hammers, and this horizontal shaft may have a fly-wheel upon it, to regulate the motion and render it uniform.

Mr. Smeaton’s proportions for a fulling-mill for two pair of flocks were as follows:—The water-wheel, 14 feet diameter, 7 feet broad; it was a breasting-wheel, and the fall of the water was five feet from the surface of the mill-pond to the tail-water below. The spur-wheel on the axis of the water-wheel 72 cogs, and 9½ feet diameter; the lantern turned by it 23 rounds. Upon the same shaft as this lantern was a fly-wheel of eight feet diameter, with a rim of half-inch iron inches square, and also the two cogs or tappets for each of the four hammers forming two pair of flocks. The same mill was adapted to be turned by the power of horses in dry season; for this purpose, another lantern of 13 teeth was applied on the other end of the same horizontal axis, which could be occasionally turned by a horizontal cog-wheel of 90 teeth and 12 feet diameter, fixed on the vertical shaft, which the horfes turned. The levers by which the horfes drew were 15 feet long, so that the horfes’ track was 30 feet diameter.

It required four horses to work one pair of flocks in this mill, and when Mr. Smeaton tried the expenditure of water at this mill, and also at another mill with an over-shot-wheel, he found it required from 1200 to 1400 cubic feet of water per minute, falling one foot, to work a pair of flocks. Taking the force of a horse at 352 cubic feet per minute raised one foot, this is very nearly equal to four horses. These flocks were used for fulling of bays, and we apprehend the power for working the fulling-mills for broad-cloth is greater.

Proceeds of Milling.—A piece of cloth of sixty-two yards long has six pounds of soap allowed for it, which is dissolved in water, and a handful spread upon every yard in length; the piece is then put into the trough of the mill, and worked for three hours; during this time the cloth is frequently moved in the trough, to expose fresh surfaces to the action of the hammers. The blows upon the cloth cause a motion of the fibres of the wool amongst one another, and the soap facilitates this motion; the fibres of the wool have the singular property of moving always forwards in the direction of the roots of the hairs, when a number of hairs are rubbed or worked together, but they will not retreat in the opposite direction; this produces the matting or entangling of all the fibres together. After three hours milling, the piece of cloth is taken out of the trough, and soaped again, then returned and milled again for three hours. This is repeated four times, making twelve hours milling in the whole, and then a stream of fair water is admitted into the trough, to wash away the soap. The piece of cloth, when taken out of the mill the last time, is generally found reduced to about 60 inches broad, and 40 yards in length; before the operation, it was 100 inches broad, and 62 yards in length.

The operation of felting is so well explained by M. Monge, in the Annales de Chimie, that we think proper to give an extract from his memoir, in addition to what is stated in our articles Felting, Fulling, and Wool.

If we examine a human hair, a fibre of wool, or the hair of a rabbit, hare, beaver, &c., in a microscope of the greatest magnifying power, the surface of each hair appears smooth and even; or at least if any inequalities are perceptible, they seem rather to arise from some difference in the colour and transparency of particular parts of the fibres than from the irregularity of their surfaces; for their images, when viewed by a polar microscope, are terminated by even lines, without any roughness. Nevertheless it is probable the surfaces of these objects are formed either of laminae, which cover each other from the root to the point, much in the same manner as the scales of a fish cover the animal from the head to the tail; or fill more probably of zones placed one over the other, like what is observed in the structure of horns; to this conformation it is, that such substances owe their disposition to what is called felting.

If with one hand we take hold of a hair by the roots, and draw it between two fingers of the other hand, towards the point, we are hardly sensible of any friction or resistance, nor can we distinguish any sound; but if, on the contrary, we draw it between the fingers from the point towards the root, we are sensible of a resistance which did not exist in the former case. A sort of tremulous motion is also produced, which is not only perceptible to the touch, but may also be distinguished by the ear.

It is evident, therefore, that the texture of the surface of a hair is not the same from the root towards the point, as from the point towards the root. As this texture is the principal object of the present memoir, it is necessary to demonstrate it by some other observations.

If a hair is held between the fore-finger and thumb, and rubbed by them backwards and forwards alternately in the direction of its length, a progressive motion of the hair will take place; but this motion is always with the root forwards, although the rubbing of the finger and thumb is alternately in both directions. This effect does not at all depend on the nature of the skin of the fingers, or its texture; for if the hair be turned, so that the point is placed where the root was, the movement then becomes contrary, viz. its motion is always directed towards the root.

What is observed in the above instance is entirely analogous to what happens when country children, by way of sport, introduce an ear of rye between the writh and the shirt-sleeve; the points of the beards of the ear are directed outwards, and by the various motions of the arm, this ear, sometimes catching against the shirt, sometimes against the skin, takes a progressive motion backwards, but the beards always resist its return, so that it soon gets up to the arm-pit. It is very clear, that this effect is produced by the asperities upon these beards, which being all directed towards the point, do not permit the ear to move in any other direction than towards that part which was united to the stalk. There can be no doubt that it is the same with respect to hair, and that its surface is beset with asperities, which being laid one upon the other and turned towards the point resist all motion, except towards the root.

These observations, which it would be useless to multiply, relate to long hair, which have been taken as examples; but they apply with equal propriety to wool, furs, and in general to every kind of animal hair. The surface of all these is, therefore, to be considered as composed of hard lamelle placed one upon another, like tiles, from the root to the point; which lamelle allow the progressive motion of the hair towards the root, but prevent a similar motion towards the point.

From what has been said, it will be easy to explain why the contact of woollen stuffs is rough to the skin, while that of cotton or linen cloths is smooth: the reason is, that notwithstanding the flexibility of each particular fibre, the asperities
WOOLLEN MANUFACTURE.

perities upon the surface of the fibres of the wool, by fixing themselves in the skin, produce a disagreeable sensation, at least till we are accustomed to it; whereas the surface of the fibres of hemp or flax, of which linen is made, being perfectly smooth, do not cause any such sensation. It is also probable, that the injury arising to wounds or sores from the application of wool does not proceed so much from any chemical properties, but is occasioned solely by the form of the surface of the fibres, the perities of which attach themselves to the raw and exposed flesh, which they stimulate and irritate to such a degree as to produce inflammation.

The perities with which the surface of wool is every where surrounded, and the disposition which it has to assume a progressive motion towards the root, renders the spinning of wool and making it into cloth difficult operations. In order to spin wool and afterwards to weave it, we are obliged to cover its fibres with a coating of oil, which, filling up the cavities, renders the perities less sensible; in the same way as oil, when rubbed upon the surface of a very fine file, renders it still less rough.

When a piece of cloth is finished it must be cleansed from this oil, which, besides giving it a disagreeable smell, would cause it to foil whatever it came in contact with, and would prevent its taking the colour which is intended to be given to it by the dyer. To deprive it of the oil it is scoured at the fulling-mill, by working it with hammers in a trough full of water or urine, in which fuller's-earth is sometimes mixed. This earth combines with the oil which it separates from the cloth, and both together are washed away by the fresh water, which is afterwards brought to it in the machine. Thus after a certain time the oil is entirely washed out of the cloth.

The fulling, which succeeds the scouring of the cloth, is aided by the application of the soap. The alternate pressure given by the hammers to the piece of cloth, especially when the mill is very far advanced, occasions an effect analogous to that which is produced upon hats by the hands of the hatter; the fibres of wool which compose one of the threads, whether of the warp or the weft, assume a progressive movement with their roots forwards, and introduce themselves among the fibres of the threads nearest to them, then into those which follow; and thus by degrees all the threads, both of the warp and the weft, become felted together. The cloth, having by the above means become shortened in all its dimensions, and thickened in its substance, partakes both of the nature of cloth and of that of felt; for at the same time that the threads give it considerable strength, it may be cut without being subject to ravel, and on that account we are not obliged to hem the edges of the pieces of which wearing apparel is made. Lastly, as the threads of the warp and those of the weft are no longer so distinct and separated from each other as to leave interfices between them, the cloth forms a warmer clothing, independently of its having acquired a greater degree of thickness. Knit work is also rendered less apt to run, in case a fitch should drop, by the operation of fulling.

Tentering.—When the mill is finished, the cloth is stretched again on the tenter. It is usual to extend the piece to forty-two yards in length, but not at all in breadth; indeed only one inch of extension in each yard is allowed by law. The cloth remains in the open air until it is perfectly dry and ready for the succeeding operations of finishing, which are only intended to give it a beautiful surface, for it already possesses all the useful qualities of cloth.

Drifling the Cloth with Teafels.—This operation is to raise up the nap or loose fibres on the surface of the cloth, by scratching it over with a species of thistles called teafels, in order to form a wool on the surface, which can be removed by sheerin. The teafels are the balls or ears which contain the feed of the plant called dipiacus futtonum; the scales which form the ball project on all sides, and are terminated with sharp points, which turn downwards, like hooks, and are very elastic. See Teafel.

A number of teafels are put into a small frame, which is composed of a handle eight or ten inches long, having a small ftick paffed through it at one end about eight inches long, which is fplitted into two at each end nearly all its length.

When the frame is paffed through the handle near the middle of its length; the two fplitted sticks are perpendicular to the fem or handle, and parallel to each other. The space between them is filled with teafels, which are jambed in very falt between them, and also in the clefts of the fplitted sticks, where they are fecured by ftrings extended between the ends of the fplitted sticks, and twisted, until they draw the sticks forcibly together, and bind the teafels very falt. This frame filled with teafels forms a tool, which very much remembles the curry-comb used to clean horses, and is ufed in a fimilar manner, to scratch over the whole surface of the cloth, and draw out all loose ends of the fibres of the wool, which are not firmly confined by the entanglement of the felting.

The drifling is performed by two men, who hold the teafel-frame by its handle, and work the cloth, when it is hung up in a vertical position over two rails fixed to the ceiling; when they have worked over as much surface as they can reach, they draw down a fresh portion, which they work in turn, and thus proceed until they have finished the whole piece. The first time the cloth is drifled it is wetted with water; it is worked three times over in the wet flate, by frokes in the direction of the length of the piece, and then it is worked again three times in the other direction; by this means all the fibres are raised, and the cloth is prepared for shearing.

In the most improved manufactories, the drifling is performed by the gig or gig-mill. This is a cylinder covered on its surface with teafels, and turned rapidly round whilst the cloth is drawn over it.

The Gig-mill is represented in perspective in Plate V. Woollen Manufacture. M is the wood frame of the machine; F F is the cylinder or drum, which is composed of 12 rails or troughs, filled with teafels F F, 3, 4, &c. These are fastened on the circumference of two or three wheels fixed upon a wooden axis Z; the drum is put in motion by a pulley E D at one end of its axis, which receives an end-leaf strap, 2, from the drum C, situated above the machine. There are two pulleys, E and D, one fixed on the axis, and the other fitted on loofely, with liberty to turn round freely upon it; the strap can be shifted to either pulley, and accordingly the machine will be put in motion, or will stand still.

The drum C is fixed on one end of an iron flhaft 1, which is put in motion by a bevelled wheel B, from the larger wheel A, fixed on the great horizontal flhaft, which proceeds the whole length of the mill. The drum, F F, covered with teafels, is mounted on bearings supported by the frame, and the piece of cloth G is conducted over it, to receive the action of the teafels; one end of the piece of cloth is wound round a roller J, and the other end of the piece is wound on the roller L; both these rollers are put in motion from a bevelled wheel G, fixed on the extremity of the axis of the drum; this turns a wheel H upon an inclined axis, which has a pinion at each end; one of these pinions, q, turns a bevelled wheel K, on the end of the axle of the upper roller
WOOLLEN MANUFACTURE.

The drum or cylinder of the gig-mill is composed of a number of shallow troughs, fixed on the circumference of the wheels of the drum, and parallel to its axis: into these troughs, frames filled with teals, like those we have before described, are fastened in a very simple manner; and the frames are placed so close together, that the trough is wholly filled, and forms a continuous surface of teals to act upon the cloth when the cylinder revolves. When the hooks of the teals become filled with flocks or fibres of wool, which they have drawn out from the cloth, they are removed from the cylinder, in order to be cleaned by children, who pick out the flocks with a small steel comb.

The teals are cultivated very largely in the clothing countries; but it sometimes happens, in particular seasons, that the crops fail, and they are then very dear. This has produced many trials of metallic teeth as substitutes for teals. Mr. Price of Stroud, in Gloucestershire, has two patents, dated 1807 and 1817, for this object; Mr. Laffale of Bristol took a patent in 1816, Mr. Williams of Furlsey in 1817, and Messrs. Lewis of Brincomb in 1817. We are not informed if any of these inventions are yet brought into real use in the manufacturing districts.

Shearing or Cropping the Cloth.—By the operation of the teals, the wool is become raised all over the surface of the cloth in a loose fur, which must be removed by shearing before the cloth will be fit for wearing, because the fur would gather dirt and dust, and would wear very unequally.

The shears used for cropping by hand are the same as those used in the common shearing-machine, and are represented at E, E, in Plate III. Woollen Manufacture. The clothier's shears consist of two very large flat blades of steel, united together by a frame of steel, which is bent into a circular bow, and is sufficiently flexible to allow one of the blades to be moved upon the other, in order to make them cut. Both blades are ground to sharp and straight edges, which apply one to the other, but the blades are not in parallel planes, like scissors, for one of the blades is laid quite flat upon the cloth, and the plane of the other blade will then be inclined to the cloth at about an angle of 45 degrees, as is shown in Plate III. The cutting-edge of this inclined blade bears upon the surface of the flat blade, and the spring of the bow is so set, as to preclude the two edges always in contact. The lines of the edges of the two blades are not parallel to each other, but inclined, so that the edge of the upper blade crosses the edge of the lower blade, and bears upon the flat surface of that blade, at the end nearest to the bow, whilst the other end of the edge of the upper blade is removed over the edge of the lower blade, thus leaving an interval between the two edges, when the shears are open, as is plainly shown in the figure. In this state, the shears being open, if the lower blade is laid flat upon the surface of the cloth, the nap or wool, which is to be removed by the cropping, will stand up above the edge of the lower blade, in the interval between the two edges; then if the blades be forced together, the edge of the upper blade will pass or crofs over that of the lower, and cut away all the wool which projects above the edge of the lower blade.

The contact of the cutting-edges begins at the end nearest to the bow, and proceeds regularly to the other, because, as before mentioned, the edges are not parallel to each other. The blades open or return to their former position by the elasticity of the bow, but in order to make the cut they are closed by means of a handle or lever 10, which is fitted or lodged on a round part of the frame of the bow, so as to play thereupon as upon a centre of motion. A double cord is made fast to the lever or handle near to this centre, and the
the other end of the cord is fastened to a block of wood, which is screwed to the flat of the lower blade, and rises up to a proper height. By depressing this handle, the shears are closed, and make their cut with the greatest facility, the elasticity of the bow returning the handle.

The manner of cropping with these shears is as follows:—The piece of cloth is laid down in folds upon a plank or low bench placed on the ground, and the end is drawn across a table or bench, which is covered with cloth, and stuffed with horse-hair, like a cushion. The cloth is stretched out flat upon the surface of the table, and is retained by hooks and weights. Two workmen are employed to shear a piece of cloth; they place the lower blades of their shears flat on the surface of the cloth, with the line of the edge in the direction of the length of the piece; one of the shears is laid on the edge or lift of the cloth, and the other exactly in the middle of the breadth of the cloth. The bows and items of the shears project over the edge of the table, and the workmen place themselves at that edge. Each man guides the shears with his left-hand, and makes the cut with his right. To hold the shears by, a short staff is lashed to the bow of the shears, and secured by a stay to the lower blade; its direction is nearly parallel to the back edge of the upper blade. The workman puts his arm through the bow as far as the elbow-joint, then lays the fore-arm flat against the staff, which he grasps with the hand; and in this way he has a great command of the shears, leaving the right-hand at liberty to work the handle which closes the shears. This handle is moved backwards and forwards with great rapidity, to make cuts or clips on the cloth, and between every cut the lower blade is moved a small space on the cloth, to cut in a fresh part.

The art of shearing consists in moving the shears with great regularity and parallelism, so that every part of the surface shall be equally cropped. The clefenes with which the shears cut is regulated by weights laid upon the flat of the lower blade; these press the blade down into the soft cushion on which the cloth is spread, so that the fur will stand up more above the edge of the blade.

As the two shearmen advance in their work, their shears proceed across the breadth of the piece of cloth, and when the man who began in the middle has worked to the lift of the cloth, the other who began at the lift will have worked to the middle, where the first began; the whole breadth is now thorn, and they remove the shears, and draw the piece of cloth forwards across the table, to obtain a fresh surface to work upon.

For shearing common cloth, it is cut wet the first time, then it is dried again with teals, dried on the tenter, and cut again in a dry flate three times over.

Shearing-Frame.—The most common machine used in Yorkshire is only applied to give motion to the same kind of shears as are used for cropping by hand, and is usually called the shearing-frame. At the side of the table or cushion on which the cloth is spread, a long stool is placed, having grooves at the edges to guide the wheels of a carriage, to which the shears are affixed by their bows. There is a carriage for each pair of shears, and they are slowly and gradually moved along the stool, by a cord which winds upon a roller turned by wheel-work; and at the same time, the handles of the shears are continually pulled by a cord connected with a small crank, which turns round very rapidly. The direction of the cuts is the lengthways of the piece of cloth, and the two pair of shears advance across the breadth of the piece until a whole breadth is cut; the machine is then stopped, the shears removed, and the piece of cloth shifted upon the table. These shearing-frames operate very well, but require great care and attention to make the different cuts join, in order to cut equally over the whole surface.

The machine invented by Mr. Harmar of Sheffield was of this description; his first patent was in 1787, and another in 1794. At one period his machines were in general use, but the present shearing-frames, although of the same kind, are very much simplified, and work equally well.

A perpetual Shearing-Machine is represented in Plate III. Woollen Manufacture; it is used in the west of England, and is best adapted for narrow cloths. The shears lay croffwise over the piece, which is drawn regularly beneath the shears in the direction of its length without any interruptions; hence it is called a perpetual shearing-machine.

The shears, E E, are the fame as what we have already described. Each pair is fastened across the frame by means of a piece of wood, to which the lower blade of the shears are screwed; immediately beneath this blade is the cushion to bear the cloth, which presses between the blade and the cushion. The piece of cloth is wound round the roller C, upon the end of which is a wheel N, and a lever M, which bears up against the lower part of this wheel with so much friction as to make the cloth strain tight in drawing off from the roller. The cloth first passes over a rail B, from which it proceeds in a horizontal direction beneath the two pair of shears E E, then turns over another rail at the other end of the frame, and descends to a roller D, which is turned round slowly by the machinery, in order to wind up the cloth.

The machine is put in motion by the endless strap round the drum F upon a shaft, which proceeds all the length of the mill. The strap turns the pulley G upon the end of the small horizontal spindle H: in this spindle two cranks are formed at a and b, which are connected, by wires 7 and 8, with the handles 9 and 10 of the shears E E, so as to give them a continual motion, and make a cut of each pair of shears every time the spindle H makes a turn. The motion of the machine can be stopped by releasing the lever P, on which the bearing of the spindle is freed when the lever P is depressed, and kept down by the catch, as represented in the drawing, the endless strap is drawn tight, so as to turn the spindle; but if the catch is removed, and the lever raised up, the strap becomes loose, and slips round upon the pulley without turning it. A small pulley is fixed upon the spindle at I, to receive an endless strap which passes round a larger wheel J. Upon the same axis with this are three other pulleys of different diameters, which receive a strap 2, and give motion to three similar pulleys fixed upon a spindle 3; the latter spindle has a pinion on the end of it, which works a bevelled wheel fixed on the end of the roller D, and thus it is turned slowly round. The three pulleys on the spindles 3 and J are placed reversed to each other, that is, the smallest pulley on one is opposite to the largest on the other; by this means, the same strap 2 may be shifted, and will work upon any of the three pair of pulleys, but each one will communicate a different degree of movement to the roller D, and consequently to the cloth, so as to draw it quicker or slower, and make the successive cuts of the shears at a greater or less distance slower or pleat.
WOOLLEN MANUFACTURE.

applied to the shears themselves, instead of to the cushion or bed, and is much more convenient.

The perpetual machines answer very well for shearing narrow cloth, when the shears can cut at once across the whole breadth; and then as the two shears E work in succession over the same surface, they crop the cloth twice over in paffing once through the machine. It has been attempted to shear wide cloths in this machine, by making one pair of shears take one half the breadth, and the other pair the other half; but it is very difficult to draw a wide piece of cloth so evenly over the cushions, as to keep it stretched to the full breadth without any wrinkles in the lengthways of the piece; and if there are any such wrinkles, the cloth will be cut very irregularly. In this particular, the first machines have the advantage, because the cloth is stretched over the cushion by the workman with dexterity, and he makes it tight before the cropping is begun.

There have been many patents for the improvements of shearing-machines. Mr. Buffington’s, in 1804, is for a method of stretching or extending the cloth breadthways whilst it is in the shearing-frame. His plan is to attach a narrow web of strong cloth to the lifts of the cloth, by sewing or lacing; the outer edge of this web is also fed to a cord or small rope, so that the cloth becomes edged or bordered with ropes. These ropes are conducted through holes or openings in the frame, which will suffer the cloth and ropes to be moved in the direction of their length; but as the ropes cannot draw sideways out of these openings, the cloth may be continually stretched in its breadth. The openings should have rollers to facilitate the motion of the ropes.

Mr. Joseph Fryer’s patent shearing-machine, dated 1802, acts with three shearing-blades, one long one, which extends across the breadth of the piece to form the lower or fixed blade, and two other moveable blades of half the length, which are jointed to the long blade at the two ends, and are moveable thereon, so as to cut in the manner of scissors-blades. The moveable blades are placed into contact with the edge of the fixed blade by springs, and are put in motion by means of two cranks upon an horizontal spindle, so that the blades make their strokes or cuts alternately. The edge of the lower blade is a straight line, but the edges of the moveable blades are convex on the cutting side, so as to cause them to intersect the edge of the lower blade always in the same angle when they are wide open, as when they are nearly closed.

The piece of cloth is conducted over proper rollers, and wound up by one, which is turned round by the machine, so as to draw the piece of cloth from one end to the other with a slow and progressive motion. The cloth, when it is immediately beneath the edge of the long blade, is bent suddenly over a narrow ridge of metal, which is parallel with the edge of the lower blade, but so far distant as to permit the cloth to pass between them. This ridge of metal is capable of adjustment by means of screws, and can be placed so that the nap of the cloth will be shorn longer or shorter, as it is required.

In some cases, especially in finishing broad-cloths, instead of drawing the piece from end to end, it may be more convenient to cause it, or part of it, to move under the shearing-blades from lift to lift, or from one side to the other. This will require a machine considerably larger, though the same blades will suffice; or it is found equally convenient to cause the blades, at the time they are cutting, to move over the cloth in any direction, but more especially from lift to lift.

Mr. Fryer also contemplated the finishing of the cloth by the same machine which performed the shearing. Thus after the cloth has undergone the operation of shearing or cropping, in its passage down to the cylinder on which it is wound up, it is exposed to a current of steam thrown out from a horizontal tube at a number of small apertures, so as to give softness and pliability to the cloth; a brushing cylinder is next made to move against it, by which the remaining wool or fur is laid in one direction. It then passes between two polished metal cylinders, which are made hollow, and kept hot by the admission of steam or otherwise. These occasion a great preasure on the cloth, and dissipate all the water imbibed from the steam.

Rotary Shearing-Machine.—A very complete machine for cropping cloth of any breadth was invented by Mr. Price, of Stroud, in Gloucestershire, and for which he obtained a patent in 1815. This machine shears or crops the cloth across the breadth, beginning at one end of the piece, and continuing regularly to the other. For this purpose, the cloth is conducted through the machine by the motion of rollers, and is drawn over a bed or support which lies beneath the stationary or fixed blade of the shears or croppers, (which answers to what is called the ledger-blade in the common shears,) so that the cloth passes between the bed and the stationary blade.

The moving blades of the shears are fixed on the circumference of a cylinder situated above the fixed blade, with its axis exactly parallel thereto, and capable of revolving by the power of machinery, so that the edges of the moving blades will be carried against and passed over the edge of the fixed blade, in order to cut away all the wool of the cloth which rises above the edge of the fixed blade. Several such moving blades are fixed on the same cylinder, to act in succession against the fixed blade; and these moving blades are placed obliquely to the axis of the cylinder, or in such a manner as to form portions of spirals; but as all parts of the cutting edges are equidistant from the axis of the cylinder, it is manifest, that in the revolution of the cylinder, every part of each spiral edge is brought in succession into contact with the fixed blade, so that in its revolution it crops off all the wool, which by the progressive motion of the cloth over its bed is raised up against the fixed edge. The edges of the moving blades are placed at such a degree of obliquity to the axis of the cylinder, that at the same instant the end of one effeats to cut against the edge of the fixed blade, the following revolving blade will begin its action at the other end of the cylinder; therefore, by the time that any one of the revolving edges has passed over and made its cut against the whole length of the fixed blade, and is ready to quit it, the succeeding revolving edge is brought into action, and when this has passed, the next in succession begins, so as to keep up a continued action.

The cloth is stretched in width by a contrivance which he calls stretching-bands, to prevent it getting into folds or wrinkles, which would be injured by the shears, or make irregularities in the shearing. These stretching-bands are endless straps or bands, each of which is extended over two wheels. The bands have sharp pins projecting from them to prick into the lifts at the edges of the cloth, and the bands being so situated that one of them lies exactly beneath each lift, will be caused to circulate round their respective wheels by the motion of the cloth. The stretching of the cloth is effected by the position of the wheels on which the bands circulate, the direction of the bands being slightly oblique to the lengthways of the cloth. The endless straps are fitted into grooves or troughs, that they are firmly retained to move straight forwards in their oblique direction; and the direction of the obliquity is such, that the bands
WOOLLEN MANUFACTURE.

bands are nearest together at that end where their pins take hold of the lifts of the cloth; but as the bands move forwards with the cloth, they recede from each other, and extend the cloth in breadth in consequence of their obliquity, which may be increased or diminished as is found necessary. The actual width between the two bands can also be regulated according to the width of the piece of cloth.

It is not usual to crop the lifts of the cloth, and indeed as the lifts are usually of thicker substance than the other parts of the cloth, they would bear up the fixed blade too high from the cloth to cut the nap quite close.

For this reason, the bed or support on which the cloth is cut is so constructed, that it can be adapted in length to the breadth of the piece of cloth between the lifts, in order that the cloth only may be supported or borne up to the edge of the fixed blade; whilst the lifts, being depressed or borne down below the level of the bed, (by thin slips of metal called guards,) will escape the action of cropping, and thereby remain with the long wool upon their surfaces. The bed by which the cloth is borne whilst it is cut is only a narrow ridge of metal, over which it passes, so as to be bent with a sudden curvature, and in this way, the nap can be cut more close and even than upon a flat bed or soft cushion. The operation of cutting is facilitated by a row of pieces of metal screwed to a strong bar, to form a straight edge, very similar to the cutting edge of the fixed blade, but thin and elastic; this edge is placed close to the elevated ridge of the bed, and presses the cloth gently down upon the bed immediately before it comes to the edge of the fixed blade, against which the nap is to be cut off; this elastic edge being placed on one side of the ridge, and the cutting edge of the lower blade on the other side, the cloth is only exposed for a very narrow space just where it comes to the cutting edge. By this means, the cloth can with safety be brought nearer to a level with the upper surface of the fixed blade, so as to shear it closer than could otherwise be done without endangering the cloth.

The ends of the ridge part of the bed are composed of a number of narrow plates of metal, accurately fitted together, and placed side by side in a mortise made in the end of the solid bed; their upper ends project out of the mortise so as to line with the elevated ridge, and form a continuation thereof; but there is a sliding piece in the bottom of the mortise on which they all bear, and the point of it is of a wedge form. By removing this wedge, any number of the moveable pieces may be let down, so as to diminish the length of the elevated part of the bed at pleasure, according to the breadth of the cloth. The whole of this machine is very well contrived to effect the desired object; it will be found fully described with drawings in the Repertory of Arts, vol. xxix. p. 65.

Frizing is an operation sometimes used in the finishing of woollen cloth; it consists in rolling up and entangling the fibres, which form the nap on the surface of the cloth into small knots or bers, which cover near the whole surface, so that the cloth appears covered with small grains, which almost touch each other.

This operation is of no utility to the cloth, and it is difficult to say for what reason it was ever practised at all. The French first introduced it, and it was so much the fashion many years ago, that no other cloth was thought comparable in beauty. At present it is but little used, except for foreign markets, where our cloth meets the French cloth, which is still prepared in this manner, but generally on the back-side of the cloth only.

The frizing is done by a simple machine, in which the cloth is drawn across a narrow table by means of rollers, to give it a very slow progressive motion. The table is covered with a coarse strong cloth, and over the table is placed a heavy plank of wood, of the same size as the table. The lower side of this plank, which bears upon the cloth, is covered with an artificial stone, composed of coarse sand, which is stuck together into a solid mass by glue or other cement, and a small but rapid reciprocating motion is given to the plank by means of two cranks of very small radius. These cranks are formed at the tops of two vertical spindles, the upper ends of which are fitted in sockets at the ends of the fixed table, and the ends which project up a few inches above the surface of the table are received into sockets formed in each end of the moveable plank. The projecting parts of the spindles are not in straight lines with those parts which are fitted in the fixed collars at the ends of the table, but are slightly cranked; hence, if the spindles are turned round, they must communicate motion to the plank, and slide it over the cloth backwards and forwards; or rather they move it with a circular motion, causing every point and grain of sand cemented to the plank to describe a small circle upon the cloth. It is this action which gathers together the fibres of the nap, and entangles them into knots or grains, as before mentioned.

To put the two spindles in motion, each one has a trundle or lantern fixed on the middle part of it, and the lower end is received in a stationary socket. These lanterns are turned round by the teeth of two face-wheels, fixed upon an horizontal axis, which lies beneath the machine. By this means, both the spindles and cranks are turned round at the same time, and with a very rapid motion. The rollers which draw the cloth forwards are turned round slowly by a communication of wheel-work, and draw the piece of cloth through the machine, that is, across the frizing-table, so that every part is in turn subjected to the action of the sand cemented to the plank. The nap must be left long for that cloth which is intended to be frized, and the operation is repeated twice or three times. See some further particulars in our article Frizing, vol. xv.

Frizing.—After being horn for the last time, the cloth is brushed all over, to remove the loose cuttings. This operation is now commonly performed by a machine which has two horizontal drums, or cylinders, covered with hair-brushes on the circumference. The piece of cloth is conducted over a fyltem of rollers to extend it and draw it slowly forwards: it is conducted over one of the brushing-cylinders, and under the other; and as they are kept in rapid motion by the machine, they brush off both sides of the cloth at the same time, and lay all the fibres one way.

Prissing.—This is the last finish to the cloth, and gives it a smooth and even surface. The piece of cloth is folded backwards and forwards at every yard, so as to form a pack on the board of a screw-prea; and between every fold sheets of glazed paper are placed, so that no part of the surfaces of the cloth can come in contact; also at every twenty yards three hot iron plates are put in between the folds, the plates being laid side by side, so that they occupy the whole surface of the folds; and thin iron plates, which are not heated, are also put above and below the hot plates to moderate the heat. When the pack of cloth is properly folded, and the press contains a proper quantity, the screw is forced down to give a very severe pressure to the pack. The cloth remains in the press until the plates are quite cold; it is then taken out and folded again, so that the creases of the former folds will come opposite to the surfaces of the paper, in order to be pressed with other hot plates.

The heat tends to soften the fibres of the wool, and the pressure
WOOLLEN MANUFACTURE.

preasure against the glazed paper, whilst they are fo softened, lays all the fibres flat and smooth; so that the cloth has a very glossy appearance, and feels smooth, like satin; but this high finish to the cloth is very objectionable, because the slightest flower of rain will take it away, and when the drops of rain only wet it in parts, the cloth will become spotted and disfigured. For this reason, in preparing superfine cloth, the plates are very slightly warmed, and the cloth has but little gloes given to it. The glazed paper is a thick kind of cartridge, which is prepared by glazing or rubbing it very forcibly with a flint, as it lies upon a hard metal table. This operation is done by a water-mill.

For coarser cloths, some manufacturers gloes them with a large hot iron; it is a hollow box, into which a red-hot heater is introduced. The cloth is spread out upon a large flat table, and extended by hooks. The iron box is supplied by a tacle from the ceiling, so that it can be hoisted over to the middle of the table, and then two men work it backwards and forwards over the whole surface of the cloth, by means of two long poles or handles, which are jointed to it at one end.

The cloth is now finished, and is packed up in bales of twenty or twenty-five pieces, in order to be transported. The bale is first inclosed in paper, and then in canvas, and closely compassed by the screw-pres. Some manufacturers use the hydrostatic presses for this purpose.

In considering the processes of the woollen manufacture, as they were practiced forty or fifty years ago, and comparing them with the present practices, we find great changes and improvements, but they are by no means carried to so great an extent as in the cotton manufacture. This is owing in a great degree to the circumstance that the manufacture of woollen cloth was rendered very perfect, as far as the goodnes and beauty of the cloth was concerned, long before the improved system was begun; and there were great numbers of experienced and able workmen trained up for the processes, who by habit and dexterity performed their work as well as it could be done by machinery. The reduction of labour, or the substitution of ordinary hands for experienced workmen, was in this case all that machinery of the most perfect kind could effect; both these were advantages to the public and the manufacturer, but were so directly opposite to the inclination and interest of the able workmen, that we find they have made greater and more effectual opposition to the introduction of improvements in the woollen than in any other of our great manufactures.

At various periods attempts have been made by the workmen to suppress machinery, and many mills have been destroyed. In July 1802, considerable riots took place in Wiltshire and Somersetshire, in consequence of an attempt to set up the machines called gig-mills. It was contended that this was the same machine which was prohibited by an ancient statute of Edward VI. The disputes ran so high, that the attention of parliament was called to the subject of the laws then existing for the regulation of the woollen manufacture, and a committee was appointed to investigate the policy of encouraging or regulating machinery. In consequence, all the prohibitions of machinery were suspended. The report of this committee contains the following remarks, some of which are applicable to other manufactures as well as the woollen.

The introduction of the gig-mill and other machines was opposed from an idea that it would throw a considerable number of hands out of work; and it was contended, that it was highly injurious to the quality and texture of the cloth. With respect to the actual effects of the gig-mill and shearing-frame on the cloth, the committee report that declarative evidence has been adduced before them by merchants and manufacturers of the greatest credit and experience, to prove that these machines, especially the gig-mill, when carefully employed, finish the cloth in the most perfect manner, and that manufacturers residing in parts of the country where the gig-mill is not used, frequently send their cloths to a distance to be dressed by it.

It also appeared in evidence, that alarms similar to the present had existed among workmen at the introduction of several of the machines which are now in general use. Such alarms have gradually subsided as prejudice died away; and the machines are now fully establishe, without, as it appears, impairing the comforts or lettering the numbers of workmen. The committee remark with much satisfaction, that in many instances in which it was apprehended that the introduction of particular machines would throw such a number of people out of employment as to occasion great disaffections, the result has been very different; for besides the occupations which the attendance on such machines has given rise to, a fresh demand for labour to an immense extent has arisen out of the increased sale of the article, in consequence of the cheapness and superior quality of the manufacture.

They approve the system of patents, by which the inventor of any new machine secures to himself the exclusive benefits of his discovery for fourteen years; and only, at the end of that term, they are thrown open to the public; this provides in most cases against the too sudden and general establishment of any invention, by which a number of workmen might at once be thrown out of employment.

They next observe, that if the principles on which the use of these particular machines is objected to were once admitted, it would be impossible to define the limits or to foresee the extent of their applications. If the parliament had acted on such principles fifty years ago, the woollen manufacture could never have attained to near its present extent. The rapid and prodigious increase of late years in all the manufactures and commerce of this country is universally known, as well as the effects of that increase on our revenue and national strength. In considering the immediate causes of that augmentation, it appears to the committee, that it is principally to be ascribed, under the favour of Providence, to the general spirit of enterprise and industry among a free and enlightened people, left to the unrestrained exercise of their talents in the employment of a vast capital, pushing to the utmost the principle of the division of labour, calling in all the resources of scientific research and mechanical ingenuity, and, finally, availing themselves of all the benefits to be derived from visiting foreign countries, not only for forming new and confirming old commercial connections, but for obtaining a personal knowledge of the wants, the tastes, the habits, the discoveries and improvements, the productions and fabrics, of other civilized nations. Thus bringing home facts and suggestions, perfecting our existing manufactures, and adding new ones to our domestic stock; opening, at the same time, new markets for the product of our manufacturing and commercial industry, and qualifying ourselves for supplying them.

The committee declare it to be their opinion, that by these means alone, and above all by the effect of machinery in improving the quality and cheapening the fabrication of our various articles of export, notwithstanding a continually accumulating weight of taxes, and with all the necessaries and comforts of life gradually increasing in price, (the effects of which on the wages of labour could not but be very considerable,) our commerce and manufactures have also been increasing in such a degree as to surpass the most sanguine calculations of the ablest political writers who have speculated.
lated on the improvements of a future age. The exports of woollen goods at the time of this report, (1807,) amounted to fix millions of pounds official, or nine millions of real value.

It appeared also to be an important consideration, of which we should never lose sight, that we are at this day surrounded by powerful and civilized nations, who are intent on cultivating their manufactories and pushing their commerce; and who are more eager to become our competitors in trade, from having witnessed the astonishing effect of our commercial prosperity.

The attempts which have been made to carry our machines and implements over to foreign countries, and to tempt our artificers to settle in those countries, evince the importance of machinery, under the directions of men of approved skill, in constructing and using them. It is needless to remark how much these attempts would be favoured by our throwing any obstructions in the way of enterprise and ingenuity, and the free application of capital in this country; for any machines which should be prohibited here would infallibly find their way into foreign nations in a very short time.

Among the attempts to improve the woollen manufacture, we must not omit to notice the invention of Mr. Joseph Booth, for fabricating woollen cloth without spinning or weaving. This was effected by felting wool into a web by the aid of machinery, which operated mechanically upon a tiffue of carded wool, to entangle and interface the fabrics together. The inventor took a patent for this in 1792 or 1794, but before the time for the enrolment of the specification of his procfs, he obtained an act of parliament, the preamble of which states, that in account of the great importance of the art, and the danger of its being carried abroad to the injury of the staple manufacture of the kingdom, parliament had determined to keep the specification sealed; hence we are not able to give the details of this machinery.

We find these expectations have not been realized; for, although the process has been repeatedly tried on a large scale and in the most complete manner, it has been abandoned. Three large mills were established at Taunton and near Salisbury, by experienced woollen manufacturers of the west of England; another mill was converted to the purpose at Lewisham, in Kent; and the last mill was erected at Merton, in Surrey, the property of James Perry, esq. We learn from this gentleman, that he was able to manufacture cloth of a fine surface, and of a very even and regular substance, but it was rather deficient in strength, for want of the threads which form the substance of common cloth; and in respect to wear it was less durable than common cloth, as it did not long withstand brushing; otherwise the expence of the process, which was not one-fourth of the common process, would have brought it into general wear.

There has been a great number of other projects and patents for the improvement of different branches of the woollen manufacture; but as we have already noticed most of those which have come into use, we shall not enumerate any more of the unsuccessful attempts.

The machinery for manufacturing long combing-wool is described in the article Worsted.

WOOLLEN Nets, in Gardening, a kind of nets employed as a protection in the netting of the fruit of different sorts of tender trees. See Wooden Framts, &c.

WOOLLEN Rags, in Agriculture. See Woollen Rags.

WOOLLERS, Bleaching of. See Bleaching.

WOOLLEY-WOOLLEY, in Geography, a town of Africa, in the kingdom of Yami.

WOOLLI, a kingdom of Africa, bounded by Walli on the W., by the Gambia on the S., by the small river Walli on the N.W., by Bondou on the N.E., and on the E. by the Simbani wilderness. The country every where rises into gentle acclivities, which are generally covered with extensive woods, and the towns are situated in the intermediate valleys. Each town is surrounded by a tract of cultivated land, the produce of which is thought to be sufficient for supplying the wants of the inhabitants; the soil appeared to Mr. Park to be very where fertile, except near the tops of the ridges, where the red iron-stone and flinted shreds sufficiently marked the boundaries between fertility and barrenness. The chief productions are, cotton, tobacco, and ecoculent vegetables; all which are raised in the valleys, the rising grounds being appropriated to different sorts of corn. The capital is Madina, or Medina, signifying in the Arabic city. (See Medina.) The inhabitants are Mandingoes, (see Mandingo,) who, like most of the Mandingo nations, are divided into two great sects, the Mahometans, who are called Buhreens, and the Pagans, who are denominated indiscriminately Kafirs, i. e. unbelievers, and Sonakies, i. e. men who drink strong liquors. The latter are the most numerous, and the government of the country is vested in them; for though the Buhreens are consultated in all matters of importance, they are not allowed to take any share in the executive government, which rests solely in the Manfa, or soveraign, and great officers of the state. Of these, the first in point of rank is the presumptive heir of the crown, called the Farbona; and next to him are the Alkaids, or provincial governors, who are more frequently styled Kamons. Then follow the two grand divisions of freemen and slaves, the Slatees being considered as the principal of the former; but in all classes great respect is paid to the authority of aged men.

Park's Travels, vol. i.

WOOLLIMA, BA, a river of Africa, called also Wanda; which see.

WOOLLY-PASTINUM, in Natural History, a name given by the East Indians to a species of native red arfenic, or orpiment, found in that part of the world.

It is of a paler colour than the red orpiment of Germany.

WOOLMAN, John, in Biography, a minister of the society of Friends in North America, chiefly remarkable as an early and faithful advocate of the rights of the enslaved Africans, was born at Northampton, in Burlington county, Welf New-Jersey, in the year 1720. From some memoirs of his life left by himself, it appears that he had strong impressions of religion in childhood, which being fed by the care and admonition of pious parents, he arrived at manhood, after a struggle of some years with youthful levities, with a decidedly religious character. An incident which befell him when a child, and which he records as a proof of the early influence of divine grace on the mind, may be mentioned here, as connected with his future character, and with the first development of those tender sympathies of the heart which, under the guidance of Christian principle, fitted him so eminently to espouse the cause of the oppressed negroes. Going on an errand to a neighbour's, he observed that a robin quitted her nest at his approach, and flew about in alarm for her young ones. He took and threw stones at her, till being struck, she fell down dead. "At first," he says, "I was pleased with the exploit, but after a few minutes was seized with horror. I beheld her lying dead, and thought those young ones, for which she had been so careful, must now perish for want of their dam to nourish them: and after some painful considerations on the subject, I climbed up the tree, took all the young birds, and killed them, supposing that better than to leave them to pine away.
away, and perilih miserably. I then went on my errand, but for some hours could think of little else but the cruelties I had committed, and was much troubled. Thus He, whose tender mercies are over all his works, hath placed a principle in the human mind, which incites to exercise goodnes towards every living creature: and this being singly attended to, people become tender-hearted and sympathetic, but being frequently and totally rejected, the mind becomes fult up in a contrary disposition." Of his opinions at one-and-twenty he writes thus: "I was early convinced in mind that true religion confifted in an inward life, wherein the heart doth love and reverence God the Creator, and learns to exercise true justice and goodnes, not only toward all men, but also toward the brute creatures. I found no narrowness respecting feelings and opinions, but believed that sincere, upright-hearted people in every society, who truly loved God, were accepted of him."

The right of every individual, of whatever colour, who has not offended against society, to liberty and the common gifts of providence, was consequently at this time an article of John Woolman's religious creed: and we shall fee that he soon brought himself to act in conformity with his faith. The first occasion of trial occurred while he was yet in servitude; for he had engaged himself as clerk and attendant to a shop-keeper at a place called Mount-Holly. His employer parted with a negro, and desired Woolman to write out a bill of sale for him. "The thing," says he, "was sudden, and although the thought of writing an instrument of slavery for one of my fellow-creatures set uneasy, yet I remembered that I was hired by the year, that it was my master who directed me to do it, and that it was an elderly man, a member of our society, who bought her. So through weakness I gave way and wrote; but at the execution of it I was so afflicted in my mind, that I said before my master and the friend, that I believed slave-keeping to be a practice 'inconform with the Christian religion.' This in some degree abated my uneasiness; yet as often as I reflected seriously upon it, I thought I should have been clearer if I had desired to be excused from it, 'as a thing against my conscience: for such it was.' Accordingly, on the next occasion he took this second step. "A young man of our society," he proceeds, "spoke to me to write a conveyance of a slave to him, he having lately taken a negro into his house. I told him I was not easy to write it: for though many of our meeting and in other places kept slaves, I still believed the practice was not right." Other cases followed, in which being employed (as it appears for an adequate fee) to write the will of a neighbour or a friend, he uniformly refused to be accessory to their bequeathing as property the persons of his fellow-men. "Deep-rooted customs," he observes, "though wrong, are not easily altered; but it is the duty of all to be 'firm in that' which they certainly know is 'right for them.' A charitable benevolent man, well acquainted with a negro, may, I believe, under some circumstances, keep him in his family as a servant for no other motive than the negro's good. But man, as man, knows not what shall be after him, nor hath assurance that his children will attain to that perfection in wisdom and goodnes necessary rightly to exercise such power, &c., as that of the owner over his slave. As the first-fruits of this firmness, and which no doubt were highly grateful, he relates instances in which his refusal, and the reasons he gave for it, procured the freedom in lieu of the transmifion of the slaves in question.

Having been acknowledged by his friends in the capacity of a minister of the gospel, he made some journeys in the exercise of his gift, which served to give him a further insight into the condition of the negroes on that continent, and further excited his attention to the then practice of the society of friends, in common with others, of holding them in bondage, and even of buying them. In the year 1746 he passed through Virginia, Maryland, and Carolina, of which he writes as follows: "Two things were remarkable to me in this journey: first, in regard to my entertainment, when I ate, drank, and lodged at free-cost with people who lived in ease on the hard labour of their slaves, I felt uneasy; and as my mind was inward to the Lord, I found, from place to place, this uneasiness return upon me at times through the whole visit. Where the masters bore a good share of the burthen, and lived frugally, so that their servants were well provided for, and their labour moderate, I felt more easy; but where they lived in a costly way, and laid heavy burthens on their slaves, my exercise (trouble of mind) was often great, and I frequently had conversation with them in private concerning it. Secondly, this trade of importing slaves from their native country being much encouraged among them, and the white people and their children so generally living without much labour, was frequently the subject of my serious thoughts. And I saw in these southern provinces so many vices and corruptions, increased by this trade and this way of life, that it appeared to me as a gloom over the land; and though now many willingly run into it, yet in future the confluence will be grievous to posterity. I express it as it hath appeared to me, not once nor twice, but as a matter fixed on my mind."

It is probable that the inhabitants of the southern provinces of North America now see pretty clearly that their negro population, without consummate prudence, as well as great kindnes in the management of them, are likely one day to justify these anticipations.

On his return from the above-mentioned journey, he committed to paper his sentiments on slave-keeping, and after the MS. had lain long by him, it was published, with the approbation and at the expenditure of his friends, who began (in Pennsylvania and the Jersey's at least) to be more generally influenced by the humane and Christian views of Woolman, Benezet, and others on this subject. It was entitled "Some Considerations on the Keeping of Negroes;" and in 1752 was followed by a "Second Part," the expense of which he preferred to take upon himself, for a reason which evinces his strict regard to justice. He considered that many, who did not yet see the evil of the practice, nor approve of his writings against it, were contributors to the general fund of the society, out of which the caufe was pro-posed to be defrayed.

Some other reflections, written in 1757, while he was on a journey among slave-holders, and recorded in his "Memoir," are forcibly descriptive of his views and feelings.

The necetary brevity of this article will permit only a general account of John Woolman's labours in the caufe of humanity. From private conferences with the holders of slaves, he proceeded to public addresses to the society in their meetings for discipline: and when at length the principle of the unlawfulness to Christians of this degrading practice had been generally recognized among them, he united other members with himself in paying visits to such of the society, within his sphere of action, as required the stimulus of remonstrances to induce them to comply with the fende of their brethren on this subject. These proceedings were prosecuted through several journeys; in which at one time the religious welfare in a more general sense, at another the right conduct in this particular of his fellow-members, engaged his attention. He did not live to see the complection of his wish as it related to the society; for it was not till
till the year 1787 that the last slave disappeared from among them. But the near approach of this confusion was witnessed by his coadjunctor, Anthony Benezet, who died in 1784, whose fame has spread wider than Woolman's, because his opportunities were more extensive, who lived for the cause throughout Europe, and carried its successful plea from the narrow limits of the society of Friends into the world at large. Of this excellent man, whose biography escaped the early part of this work, it may not be too late here to record, — that he was born at St. Quintin, in Picardy, of a respectable family, in 1713; that he was carried by his father, who fled from the persecutions which fell upon the Huguenots, to London, and there formed for mercantile pursuits; that upon removing to Philadelphia with his family in 1731, having now entered into the society of Friends, he devoted his life, upon principle, first to the education of youth in useful knowledge and the Christian faith, and ultimately to the noblest toils of humanity. But to return to our present subject: in the year 1772, John Woolman, believing it his duty to pay a religious visit to the friends in England, embarked for that purpose at Chester, on the Delaware, and arrived at London in time to attend their yearly meeting. After it he travelled, exercising his ministry among his friends, through several counties, as far as York. Here, at a large quarterly meeting, he once more pleaded for the negroes, endeavoring, and probably with effect, to engage the support of those present to the cause of humanity; soon after which he was seized with the small-pox. During a feverish struggle with this disease, he manifested great patience and humility, with a firm faith in the Redeemer: and nature sinking in the conflict, he expired in peace in his fifty-second year.

As a preacher, we hear not of his eloquence nor of his learning, except, says one of the respectable friends who has favoured us with the documents of this article, "in heart-knowledge, and in the school of Christ;" but in life, he was a bright example of the integrity, meekness, charity, and beneficence which in that school alone are to be acquired; and his memory for his works' sake is blessed. Memoir of John Woolman, chiefly extracted from a Journal of His Life and Writings, London, 1815.

WOOLPER's CREEK, in Geography, a river of Kentucky, which runs into the Ohio. N. lat. 38° 53'. W. long. 88° 7'.

WOOLPIT, a village of England, in the county of Suffolk; 3 miles E. ofbury St. Edmunds.

WOOLSTONANTON, a village of England, in Staffordshire; 2 miles N. of Newcastle-under-Lyne.

WOOL-STAPLE, denotes a city or town where wool used to be sold. See Staple.

WOOLSTED. See Worsted.

WOOLSTON, Thomas, in Biography, an English divine, was born in 1669 at Northampton, and admitted in 1685 of Sidney college, Cambridge, where he was distinguished by his diligence and regularity. He was elected fellow of his college, took orders, preached with approbation, and was esteemed for his learning and piety. In his exercises for the degree of B.D. he maintained "the exact fitness of the time in which Christ was manifested in the flesh," in a discourse which was well received. But his temper being naturally enthusiastic, and pursuing the works of Origen, he indulged a great fondness for allegorical interpretations of scripture, which afterwards led him into a variety of singular and extravagant opinions. He began in 1705 with "The Old Apology for the Truth of the Christian Religion against the Jews and Gentiles revived," maintaining that all the actions of Moses were typical of Christ, and of his church; and the book was issued from the university press. Woolston remained in college till the year 1720, when he went to London, and published a Latin dissertation concerning the supposed epitaph of Pontius Pilate to Tiberius, relative to Jesus Christ. In the same year he also published two Latin epistles, addressed to Whitby, Waterland, Whitton, and others. "Circum Fideam vero Orthodoxam et Scripturam Interpretationem," defending Origen's allegorical interpretation of scripture. His deviation from the established faith was more apparent in his inquiry, "Whether the people called Quakers do not the nearest of any other sect in religion resemble the primitive Christians in principles and practice?" Blending farce with argument, he now seemed to indulge a spirit of animosity against the clergy. Declining at the same time to refuse at college, he was deprived of his fellowship in 1721. In his "Four Free Gifts to the Clergy," he denounced them "hiring priests," and "ministers of the letter." Although he might be suspected, he was not yet chargeable with historical incredulity; for in 1726 he published "A Defence of the Miracle of the Thunders of Legion against Mr. Morely." At length he engaged in the controversy between Anthony Collins and his opponents, and published "The Moderator between an Infidel and an Apologist," and "Two Supplements," in which he not only contended for mythical interpretations of the miracles of Christ, but maintained that they were never actually wrought. Confided as an avowed enemy to the Christian religion, a prosecution was instituted against him by the attorney-general, but stayed by the interposition of Whifton, and some other advocates of toleration. Notwithstanding this levity, he proceeded in publishing "Six Discourses on the Miracles," and two "Defences of the Discourses," in which, blending ridicule and buffoonery with argument, he maintained his offensive opinions. This pertinacity and rudesness of prejudiced believers in the divine mission of Christ again him; replies issued from the press; but as he again became amenable to the law, he was tried at Guildhall before lord chief justice Raymond, when, after many arguments for and against him, he was found guilty; and sentenced to a year's imprisonment, and a fine of 100l.

Unable to pay his fine, he retired within the rules of the King's Bench, and availed by an annual allowance granted to him by his brother, and the contributions of some learned and liberal friends, who vindicated his intentions, whilst they disapproved his enthusiasm and fanaticism. Among these were some, and particularly Dr. S. Clarke, who condemned every species or semblance of religious persecution, and who endeavoured to procure his release; but they could not prevail upon him to fluctuate that he would not persevere in publishing his peculiar opinions. But death gave him that release, which his friends could not obtain for him; as he was carried off by an epidemic disease, within four days after his seizure, in January 1732-3. Not long before he expired, he said, "This is a struggle which all men must go through, and which I bear, not only patiently, but willingly." His moral character is said to have been unimpeachable, and his head was thought to have been more disordered than his heart. Biog. Brit.

WOOLWICH, in Geography, a market-town and parish in the hundred of Blackheath, lathe of Sutton-at-Hone, and county of Kent, England, is situated on the S. bank of the Thames, 8 miles E. from London. The etymology of Woolwich, a name very variously written at different periods, is uncertain; according to Halsed, in his "History of Kent," one of the ancient names, Hulviz, signifies the "dwelling on the creek." The parish comprehends about
about 700 acres, of which above one-half, however, lie on the opposite bank of the Thames, in the county of Essex, and consists of marsh-land, on which stood formerly a few hovels, and a chapel of ease. The manor of Woolwich is subordinate to the royal manor of Eitham. The town consists chiefly of one narrow irregular street, confined between the rising land and the river; but several other streets, rows, and lanes, are connected with it. The church, a spacious brick building, consists of a nave, chancel, and aisles. It is situated on an eminence overlooking the town and the dock-yard, and was completed in 1740. Besides this building, Woolwich contains several different dwelling-houses.

The principal charitable establishments are almshouses and two schools. Woolwich was originally but a small place, inhabited by fishermen, and is indebted for its importance to the establishment of a royal dock there in the reign of Henry VIII. Since that time, it has gradually increased at its present augmented rate; but particularly since the establishment there of the head-quarters of the artillery and the royal arsenal; by which means the population within the last hundred years has increased six-fold.

The precice period of the establishment of the dock-yard is uncertain: it appears, however, that the Harry Grace de Dieu, of 1000 tons, was built there in 1512. The celebrated ship is floated to have been in length 128 feet, and in breadth 48 feet; she had three flush decks, a forecastle, half-deck, quarter-deck, and round-house, and carried 476 pieces of ordnance; she had eleven anchors, the largest of which weighed 4400lbs. In its present enlarged rate, the yard extends about five furlongs along the river by one furlong in breadth. It comprehends two dry docks, several slips, three malt-ponds, a smith's-shop and forge for making anchors, a model-loft, store-houses, sheds, dwellings for various officers, and other requisite buildings.

The whole is under the immediate inspection of the navy board, but conducted by several resident officers. The number of artificers and labourers employed during peace is about 1500; but in war-time it rises towards 4000. Between the dock-yard and the royal arsenal, formerly called the Warren, is the rope-walk, 400 yards in length. The military and civil branches of the office of ordnance have been established at Woolwich since the accession of George 1. In the time of peace, this arsenal is the great repository of naval ordnance, where the guns of most of the ships of war are laid up there in order. The repository contains also an extensive collection of military machines and models. The arsenal, comprehending about 40 acres of ground, contains, with other buildings, the foundry, and the late military academy, which was erected by Sir John Vanbrugh. The foundry is provided with several furnaces, the largest of which will melt about seventeen tons of metal at once. It contains also machinery for boring brasses, cannon, as they are improperly called, for they are composed of copper and tin instead of zinc. In the adjoining laboratory, bombs, carucets, carriages, &c. for the navy and army, are prepared. The number of persons employed in the arsenal during war is about 300, exclusive of the convicts belonging to the hulks or prison-flips lying in the river. The military academy, although founded in 1719, was not finally arranged till 1741, and has been fortunate in poifteeling, in the mathematical chairs, the eminent professors Derham, Simpson, and Hutton. Besides the mathematical professors, here are masters in chemistry, fortification, arithmetic, French, drawing, fencing, &c. The number of pupils or cadets, defined for the two corps of artillery and royal engineers, has been lately about 300. To provide necessary accommodation, with offices, &c. a new edifice was con-

structed and opened in 1806, about a mile S. from the town, on the upper part of the common. It is built in the calcu-

lated form, from designs by Mr. James Wyatt. The prin-

cipal front facing the N. extends above 200 yards. The expanse of the structure is estimated at not less than 150,000. The establishment is appropriated to the senior clafs of the cadets, the junior being for the preient fixed at Black-Water in Hampshire. Between this new academy and the town are extensive ranges of barracks, &c. for the royal artillery, horse and foot, which has increased during the late war beyond all former example.

The population of Woolwich, in the return of 1800, was flated at 6826, exclusive of the military, inhabiting 1352 hovels; but the number was probably under-rated; for in the return of 1811, the inhabitants are flated to be 17,054, and the houfes 2487. Woolwich-common unites with the extensive plain of Blackheath on the S., which gives name to the hundred. At its eastern extremity rife Shooter's-hill, which commands extensive and intereting prospects in all directions. The view from it of London, the Thames, and the shipping, is peculiarly impressive. Over this hill passed the great Roman road from the E. coast of Kent, through Durovernum, now Canterbury, and Durobriva, Rochester, to London. Its course is nearly pursued by the present road from Shooter's-hill, for eight miles, to a place beyond Dartford.—Beauties of England, Kent, by E. W. Brayley, 8vo. 1806.

WOOLWICH, a township of New Jerfey, in the county of Gloucefcer, with 3003 inhabitants; 10 miles S.E. of Philadelphia.—Also, a township.of the province of Maine, containing 1500 inhabitants, on the E. fide of the Kennebeck; 16 miles N.E. of Brunfwick.

WOOL-WINDERS are persons employed in winding up fheep's or wool into bundles to be packed, and fold by weight. Perfons winding and felling deceitful wool, fhall forfeit for every fleece 6d. These are fewn to do it truly between the owner and the merchant. 8 Hen. VI. cap. 22.

23 Hen. VIII. cap. 17.

WOOLRA, in Geography, a town of Hindooftan, in Vifipour; 16 miles N. of Merritch.

WOOTAMALLY, a town of Hindooftan, in Madura; 15 miles S.W. of Cooilpetta.

WOOTTON, John, in Biography, an eminent, though not very able, painter of landscape and animals, who flourifhed in England about 1720. He was a pupil of John Wyck, and was much employed in the portraits of horfes and dogs, and in painting the sports of the field, particularly fox-hunting; upon which fubjeft there are feven pictures of his engraved by Canot. Once at leaft he attempted (but he did not frequently repeat the attempt) to pourtray a battle, and his fubjeft was that of Culloden at the time of the rout of the rebel army. It has been engraved by Baron, though it is but an indifferent performance. He died in 1765. He had been fuccesful in the purfuit of his art, for he was enabled by its proceeds to build a house in Cavendifh-square, where he lived, and had painted it with taffe, according to Walpole, who praises his works ridiculoufly. His pieces, he fays, were high, forty guineas for a single horfe the fize of life, and twenty if fmalter.

WOOTTON-BASSET, in Geography, a borough and market-town of Wiltshire, England, is situated near the northern extremity of the county, at the distance of 56 miles N. by W. from Salisbury, and 89 miles W. from London. It fitts chiefly of one principal freet, about half a mile in length. The houfes are mostly conftrueted of brick with thatched roofs. Two repreffatives have been regularly depuited from this town to ferve in parlia-

ment.
ment since the 25th of the reign of Henry VI. They are elected by the inhabitant householders legally settled there, and paying feet and lot. The corporation is composed of a mayor, two aldermen, and twelve burgesses. The market-day is Tuesday, weekly; and there are also six fairs annually. In the centre of the town are a market-house and shambles; and near this is the town-hall, in which a machine, called a "eucking or ducking-stool," formerly used for the punishment of female felons, was lately transferred to the town. The church is an old building dedicated to St. Bartholomew, but it is not remarkable for beauty of architecture, nor does it contain any monument or inscription worthy of notice.

According to the population returns of 1811, the borough and parish contained 321 houses, and 1360 inhabitants, who formerly carried on a considerable trade in broad-cloths; but there is now no flod Manufactury of any fort, though some attempts have been lately made to introduce the business of rope-making and hack-making. In this parish are two free-schools and a Sunday school. The former were founded and endowed by the earl of Clarendon, one of them for twelve boys, and the other for twelve girls.

At the time of the Conquest, this place was called simply 'Wooton.' It was then the property of Milo Critpin; but in less than a century afterwards it was possessed by the Baffets of Wycomb, a branch of the noble family of the Baffets of Drayton. The present proprietor is the earl of Clarendon. The ancient manor-house, which stands on the summit of a considerable eminence, is now converted into a farm-house, whence the eye surveys a very extensive prospect into Somersetshire, Gloucestershire, &c. A variety of curiosity conical stones, resembling small fir-apples, have been dug up in different spots around the town, imbedded in a sort of blue marly stone.

Liddiard-Tregooze, or Lydiard-Tregofe, is a village and parish, situated at the distance of three miles north-east from Wootton-Basset. According to the population returns of 1811, the parish contains 95 houses, and 613 inhabitants.

The church, an ancient structure, is divided into a nave, two side aisles, and a chancel, with a square tower at the west end, surrounded by an open balustrade and angular pinnacles. The church contains several interesting monuments of the St. John family; also a very curious genealogical table, with arms, &c.

A joining to the church is Liddiard-park, the seat of lord Bolingbroke. The attached grounds are extensive, and contain many large clumps of trees, among which are a great number of old oaks.—Beauties of England and Wales, Wiltshire, by J. Britton, 1815.

Wootz, in Metallurgy, a metal extracted from an ore of iron in the East Indies, the nature of which is not known at present in Europe. Wootz is highly esteemed by the natives of India, and applied to various purposes in the arts.

Dr. Scott gave the following account of its properties, in a letter to the president of Bombay:—"Wootz admits of a harder temper than any thing known in that part of India. It is employed for covering that part of gun-locks against which the flint strikes. It is used for cutting iron on a lathe, for cutting stones, and for chisels; also for making files and saws, and for every purpose where excessive hardnefs is necessary: it cannot, however, bear any thing beyond a flight red heat, which makes it work very tediously in the hands of the smith. It has a still greater inconvenience or defct, that of not being welded with iron or steel, to which, therefore, it is only joined by screws and other contrivances." Dr. Scott observes farther, that when wootz is heated above a light red heat, part of the mass seems to run, and the whole is lost, as if it confituted of metals of different degrees of fusibility. The working with wootz is so difficult, that it is a separate art from that of forging iron. The magnetic power can only be imperfectly communicated to it. Specimens of wootz sent from India were examined by Dr. George Pearson, who states in the Phil. Trans. vol. xcvi., that they were in the form of round cakes, about five inches in diameter and one inch thick, each of which weighed more than two pounds. The cakes had almost been cut through, so as to divide it into two nearly equal parts. It was externally of a dull black colour, the surface was smooth, the cut part was also smooth, and, excepting a few small holes, the texture appeared to be uniform. No indentation could be made in it by blows with a heavy hammer, nor was it broken by blows that might have broken a piece of steel. Fire was elicited on collision with flint. It possessed the hardness of some kinds of crude iron, but did not effectually refurb the file, like highly tempered steel, and many kinds of crude iron. It admitted a polish equal to the best steel. The wootz-filings were attracted by the magnet like common iron-filings. When broken, it exhibited the fracture and colour of a rather open-grained steel. It was tafflefs and inodorous. Its specific gravity in different states, as given by Dr. Pearson, ranges from 7.2 to about 7.7, which is nearly the same as steel. From the properties of this substance, Dr. Pearson concludes, that wootz approaches nearer to the state of steel than raw iron, although it possesses some of the properties of this last substance. It is not to be referred to that kind of steel in which there is either an excess or deficiency of carbon, but it contains something besides carbon and iron, otherwise it would be common steel. The solution in nitrous and dilute sulphuric acid contained only oxyd of iron, and the residue of carbonaceous matter, as in common steel. Hence, says Dr. Pearson, it is obvious to suspect, that wootz contains oxygen, either equally united with every part of the mass, or united with a portion of iron to compose oxyd, which is diffused through the mass. To this circumstance, Dr. Pearson seems inclined to attribute the smaller quantity of hydrogen gas given out during solution, than is afforded by common steel, and to account for its partial fusibility and difficult malleability, and may be the reason of its taking a fine edge or polish. The oxyd is not perhaps equally diffused; hence the wootz is not quite uniform in its texture and hardnefs till it has been remelted. The proportion of oxygen in wootz, says Dr. Pearson, must, however, be very small, otherwise it would not possess so much strength and break with so much difficulty. The oozing out of matter when fused is analogous to what appears on refining raw iron. Although no account is given by Dr. Scott of the process for making wootz, we may without much risk conclude, that it is made directly from the ore, and consequently that it has never been in the state of wrought iron, for the cake is evidently a mass which has been fused, and appears to have been cut almost quite through while white hot at the place where wootz is manufactured. The particular use to which wootz may be applied are to be inferred from the preceding account of its properties and composition; and may be proved by an extensive trial of it in all the arts which require iron. See Phil. Trans. vol. xcvi.

WOPANKEN, in Geography, a town of Prussia, in the province of Bartenland; 2 miles E. of Bartenstein.

WOPELBAI, a river of Ofnabruck, which runs into the Dalke, 2 miles N. of Weidenbruck.

WORADA,
WORADA, a country of Africa, of an oval form, about 90 miles in circumference, S. of Konkapoo.

WORANY, a town of Lithuania; 28 miles S. of Troki.

WORBIS, or STADT WORBIS, a town of Westphalia, in the territory of Eichsfeld, on the Wippcr; 8 miles S.E. of Duderstadt.

WORBIS, Britten, a town of Westphalia, in the territory of Eichsfeld; 9 miles S.E. of Duderstadt.

WORBIS, Kirch, a town of Westphalia, in the territory of Eichsfeld; 8 miles S.E. of Duderstadt.

WORBITZ, a town of Bohemia, in the circle of Czastau; 10 miles S. of Czastau.

WORBIZT, a lake of the Ucker Mark of Brandenburg, near Joachimthal; 28 miles N.E. of Berlin.

WORBSTADT, a town of France, in the department of Mont Tonnerre; 10 miles S.S.W. of Mentz.

WORCESTER, the capital city of a county of its own name, in the W. of England, situated in N. lat. 52° 10', and W. long. 2° 00'; distant 26 miles N. from Gloucester, 27 S.W. from Birmingham, 30 E. by N. from Hereford, and 111 W.N.W. from London. The inhabitants in 1811 were, according to the returns made to parliament, 59,532 males, and 78,611 females, in all 138,144, and the houses were, in 1699, fixed at 1302, 157, 444; but now supposed to exceed 5000. The fee has paffleffed one pope, four saints, seven high-treaturers of England, eleven archbishops, besides chancellors of the kingdom, and other great officers of the state. Few places, perhaps, have suffered more than Worceftcr by the inteline broils of the country, and by casual diiftaters. Ruined by the Danes about the year 894, it was rebuilt by Ethelred and Ethelreda; but the inhabitants refusing to pay the tax called danegelt, the city was again laid waffe by Hardicanute. Again restored, it suffered severely during the contest between king Stephen and the emperour Maucl, as well as by a fire, from which the walls of the cathedral alone were preserved. Taking the part of Lewis, the dauphin of France, against king John, the king's troops exercised every tyrannical severity on the inhabitants; the church was plundered, and a heavy sum exacted from the clergy. John was nevertheless interred in the cathedral in 1216. It was in Worceftcr that, previously to the battle of Ewesham, young Edward raised the standard of loyalty for his father, Henry III. After the accession of Henry VII. several citizens were beheaded, and a fine of 500 marks was levied on the city. In 1642 Worceftcr witnessed the fanguinary contest which terminated so fatally for the affairs of Charles I. (See Charles.) In 1646, the city surrendered by capitulation to the parliament's army, having been the first city in England to declare for the crown, and the laft which held out in its defence. In 1651 happened the second battle of Worceftcr under Charles II.; a battle which decided the deftructive and vindictive controversy between the royalists and the parliamentary party, by which the latter obtained a complete ascendency; and the king himself escaped with difficulty out of the country. To preserve the memory of this success, "the lord-general Cromwell, on the 18th of September 1651," says Lach, in his Diurnal, "with many officers of the army, was at Wolfdidge, at the launching of a gallant new frigot of the flates, carrying three-score peeces of ordnance, and called her name Worceftcr."

Prefent State.—Worcefter is distinguished among the provincial towns of England for its resemblance, in various refpects, to the metropolis. It is described to be well built, well paved, and well lighted. It confisits principally of one great street running from N. to S., and terminating at the cathedral; also thirteen other collateral streets, besides lanes of inferior dimensions. The circuit of the city exceeds three miles and a half. The Severn, bathing the western side, and carrying vessels of considerable burthen, is of great utility in facilitating the commerce to and from, as well as the requisite supplies of the city. On its passage-boats sail up as far as Shrewsbury, and down to Gloucester and Bridgford. The buildings now extend beyond the ancient limits, which may, however, still be traced; the old walls, according to a plan made before the civil wars, was in extent 11,650 pages; but this wall, after the last battle of Worceftcr, was almost wholly destroyed. The castle was erected by Urfo of Abioto about 1088. The area, now called the College-green, was, in the Norman times, the outer ward of that castle, behind which to the S. was the inner ward. The buildings now exceed the ancient limits, which may, however, still be traced; the old wall, according to a plan made before the civil wars, was in extent 11,650 pages; but this wall, after the last battle of Worceftcr, was almost wholly destroyed. The castle was erected by Urfo of Abioto about 1088. The area, now called the College-green, was, in the Norman times, the outer ward of that castle, behind which to the S. was the inner ward, or fortrefa itself. A gaol for the retention of the prisoners of the city is all that now remains of the castle, on the spot where the kings of England formerly kept their court. A steep artificial mount, on which probably stood the keep of the fortrefa, is a prominent object; the surrounding ditch and rampart may also be easily traced.

Cathedral.—The original cathedral of Worceftcr was founded in 680; but in 969 its revenues were transferred to

Vol. XXXVIII.
to the monastery of St. Mary, an establishment of the beginning of the eighth century. The church of this monastery being unfittable to its novel application, another cathedral was erected and consecrated by St. Oswald, the bishop, in 983. Being ruined by Hardicanute in 1041, the foundation of a new cathedral was laid in 1084, by bishop Wulstan II.; and in 1089 he finished it, together with the monastery, and called the same Monasterium St. Marie in Cryptis. The original plan of this church seems to have been a simple crofs, the entrance being at the west end of the present choir, which occupies the place of the ancient nave. This ancient structure had probably a central or principal tower; as it is recorded that the new tower fell down in 1175, and two smaller ones were destroyed by a storm in 1222. The antiquity of this part of the edifice is particularly apparent from the crypt or undercroft, which extends under the choir and its aisles. This is a curious and interesting part of the fabric. Twice severely injured by fire, in 1113 and in 1202, the cathedral was re-consecrated in 1218, by bishop Silvester, in the presence of Henry III. and his court. Six years afterwards the foundation of an additional work, the present nave, was laid by bishop William de Blois, in which is displayed the skill of the architect, in adapting the new parts to the former structure. The stone-vaulting of the edifice was begun by bishop Cobham in 1327, and the whole was finished in 1357. The beautiful central tower was constructed in 1374. Worcester cathedral is in the exterior extremely plain, and its attractions consist principally in the height, space, and the lightness of its architecture, to which the lofty pinnacles, rising from every termination of the building, as well as from the tower, not a little contribute. The external length, including buttresses, is 426 feet; the internal, 394: that of the nave, from the front to the west transept, 180; of the choir, including the organ-loft, 120; of the Lady-chapel, 60; of the west cross-chapel, 128; and of the east transept, 120 feet. The nave is separated from the aisles by ten clustered columns on each side, supporting three ranges of pointed arches; an arrangement also carried on through the choir. A stone pulpit, originally placed near the west end of the nave, is now fixed at the north side of the choir. It is of an octagonal form, ornamented with emblematic sculpture, and surmounted by a canopy.

Worcester cathedral has, like many other edifices of the same nature, been a great sufferers by the lapse of time, and by the various modes of repair adopted at different periods. It now scarcely contains one arris or moulding, as originally constructed. Roman cornices now occupy the place of battlements; buttresses are pannelled in various heterogeneous ways; pinnacles have been reflored after the Grecian school; windows formed without ramifications or cufs, and filled with modern flamed glass, delitute of subject or design; Roman arches resting on entablatures, to support or strengthen the transepts; Roman figures with leaves, instead of proper bales to regular clustered pillars. Indeed this edifice affords a curious, but not a very pleasing, display of heterogeneous parts and styles.

Of the numerous monuments contained in the cathedral, a few only can be noticed in this work. Between the pulpit and the communion-table, in the midst of the choir, is placed the altar-tomb of king John, who died in 1216. On it is extended his effigy. The inscription, "Johannes Rex Anglie," is now almost illegible. The figure, as large as life, has in the right-hand a lepette, and in the left a sword, with its point in the mouth of a lion couchant at the feet. On each side, on a level with the pavement, are small figures of bishops Oswald and Wulstan. It had long been imagined that this monument was merely an honorary monument, while the body of John really lay in the Lady-chapel; but by an investigation in 1797, the contrary was ascertained. Removing the effigy and stone on which it rested, the interior of the monument was laid open. Between two brick walls, and under some elm boards, lay a stone coffin containing the royal corpse. The body had evidently been deranged at some former period; but many of the parts were very perfect. Instead of the crown, however, as shown in the effigy, the head had been invested with the hood of a monk's cowl. The body had been enveloped in an embroidered robe, seemingly of crimson damask. The coffin rested on the pavement of the choir, and the original cover was the stone on which the effigy is sculptured. On the right-hand of the communion-table, occupying one of the arcades between the choir and the south aisle, stands the celebrated monumental chapel or chantry of Arthur, eldest son of Henry VII., and elder brother of Henry VIII. This chapel, of an oblong form, is richly ornamented on the north, west, and south sides, by open screen-work; the pillars adorned with a number of small statues, with shields, roves, and other figures emblematic of, the houses of York and Lancaster, whose contending claims to the English throne were united in that young prince, who died in 1502, in the 17th year of his age. Against the east end was placed an altar, behind which was a wall ornamented with five figures; in the centre the Saviour, on the right-hand two kings in their robes, and on the left another similar king, and a warrior in armour. Over the statues are richly-wrought canopies. To preserve these figures from destruction, they have been covered over with plaster, probably in the reign of Elizabeth, and remained thus unknown until November 1758, when the plaster being removed, they were once more laid open to view. The tomb of prince Arthur is of marble, with the arms of England and France quartered, painted on the sides; round the edge of the cover is an inscription in English.

Worcester cathedral contains also the monument of the celebrated judge Littleton, the father of English law, a judge of the common pleas under Edward IV., who died in 1481. Of more modern sepulchral monuments it will be sufficient to mention those of bishops Hough, Maddox, and Johnstone, not only for the eminent names they commemorate, but as distinguised examples of modern sculpture. Attached to the south side of the nave of the church is the ancient cloister, a square of about 120 feet, on the east side of which is the chapter-house, a deacon of 56 feet in diameter, and 45 in height, the roof of which is supported by a central column; it now serves as a library, as well as a council-room, and contains a valuable collection of books, and of manuscripts, chiefly relating to the canon law. Adjoining to the south side of the cloister is the ancient refectory of the monastery attached to the cathedral, called the college-hall, a lofty and spacious room, 120 feet long by 58 broad, now kept as the king's school. Here are also held the triennial musical meetings of the three choirs of Worcester, Hereford, and Gloucester, for the benefit of the widows and orphans of the clergy of their respective counties. This school was founded by Henry VIII. for forty scholars, who are prepared for the university, and instructed in various branches of modern education. A little to the eastward of the chapter-house stands the audit-hall, anciently called the Guelph-hall, built in 1320, for the entertainment of strangers resorting to the monastery and cathedral. It is still the scene of hospitality during the annual audits of the chapter of the cathedral. At the back of
of the seventh prebendal house, which formerly belonged to the kitchener or cook of the monastery, are the remains of the great kitchen, a spacious octagonal apartment, 34 feet in diameter.

Other places of worship belonging to the establishment in Worcester are, the churches of St. Peter the Great, St. Michael, St. Alban, St. Helen, St. Andrew, St. Clement, St. John Baptist. All Saints, St. Swithin, St. Martin, St. Nicholas, and Claines. Of these buildings, some preserve their ancient appearance. St. Andrew's church is distinguished by a square tower, 90 feet high, supporting an octagonal spire, in height 155 feet 6 inches; the whole height being 245 feet 6 inches. The church and tower are supposed to have been erected in the eleventh century, but the spire was not added till 1751. Among the various monastic institutions of Worcester was that remarkable one, now called the Commandery, established for the maintenance of two chaplains, five poor men, and two poor women, founded by St. Wulstan, who died in 1097; it became, after the dissolution, a part of the endowment of Christ-church in Oxford. Commanderies were, among the knights-hospitallers of Jerusalem, the same with the preceptories among the knights-templars; being societies placed on the country estates of the order, under the control of a commander, but accountable to the grand prior or master in London. Part of the ancient buildings still exist; but the whole, now in the possession of a private individual, has of late years undergone great alteration.

Though containing far many parish-churches in proportion to the population, Worcester is not deficient in the number of chapels for various classes of dissenters. Among these, are reckoned Anabaptists, Independents, Methodists, Presbyterians, Quakers, and Roman Catholics.

On the south side of the cathedral and cloister is an open space, called the College-green, on the east side of which is a gate, known by the name of Edgar's tower, having on the outer front the statues of that king and his two queens, Elfleda and Elfrida. Antiquarian curiosity has been much excited by characters once existing on this tower, supposed to indicate a date much older than the received introduction of our present numerical figures into this part of the world. But the characters were probably misunderstood; nor is the tower itself believed to be of the age of Edgar, who died in 975.

Northward from the cathedral, on the rising bank of the Severn, is the bishop's palace, originally surrounded with embattled walls in 1270, but brought into its present state by bishop Stillingfleet and succeeding prelates. The west side still retains much of the antique architecture.

Public Buildings.—The chief of these is the guildhall, situated on the west side of the High-street, near the marketplace. It is a handsome edifice of two spacious stories, finished in 1723: the lower part is in one room, 110 feet 6 inches long, by 25 feet 6 inches broad, and 21 feet high, in which are held the several courts of justice for the city and the county. The council-chamber is 109 feet long, by 20 broad, and 15 feet 8 inches high. The bridge over the Severn, in length between the abutments 270 feet, and in breadth 25, is a elegant Roman structure of 5 semicircular arches, opened in 1781. The centre arch is in span 41 feet, but the other arches gradually diminish in width. Connected with the bridge a new street has been opened, leading into the middle of the city, and the new roads from the westward, the embankments, and quays along both sides of the river, are at once ornamental and useful.

Charitable Institutions.—The chief of these is the house of industry, completed in 1794, a handsome building on the east side of the city, advantageously situated on an eminence, and calculated to accommodate 150 persons belonging to the different parishes of the city. The infirmary, situated in an airy position, overlooking the race-ground, the river, and the north-west part of the city, was commenced in 1767; it receives about 58 patients on an average annually. A number of hospitals and alms-houses, some of ancient foundation, provide support for age, and education for youth. A free-school on the Lancastrian plan was established some years ago. The old county gaol is situated in the castle-yard; but a new one has been lately erected in the neighbourhood of the infirmary, on the Howardian plan. The city gaol is an ancient building in a crowded situation, having been originally a Franciscan convent, founded in the 13th century, but granted to the city at the dissolution.

Public Amusements.—Worcester has long maintained its claim to be one of the most fashionable cities in the western parts of the kingdom; it is consequently the winter-residence of a number of considerable families from the surrounding counties of England and Wales. The theatre, assemblies, concerts, races, the various public walks, clubs, the public library, &c. render Worcester a busy, gay, and much-frequented city.

Municipal Government.—The city was incorporated by Henry I., but the first charter was granted in the 45th year of Henry III. In 1521, the 19th year of James I., a mayor was established. The corporation now consists of a mayor, six aldermen, 24 common-council-men, and 48 officers, by which last two bodies the magistrates are chosen. But the right of electing the members for parliament extends to upwards of 2000 citizens, the sheriff being the returning officer. Worcester sent two representatives to parliament in the 23rd year of Edward I. Florence of Worcester, the author of the Chronicron, a general history of the world down to 1118, when he died, was a monk of the cathedral of this city. William of Worcester was educated in Oxford in 1434, and drew up his "Polyandra Oxonienis," a history of the learned men bred in that university. His Annals, at the end of the "Black Book" of the exchequer, contain notes on the affairs of his own times. The famous empirical and mystic philosopher, Edward Kelly, was born in Worcester towards the middle of the 16th century. The relation of the impostures of this person and his associate Dr. Dee, furnishes a humiliating picture of the human mind and understanding in those days, on the continent as well as in England. Worcester produced, in 1650, the eminent lawyer lord Somers, who, by his knowledge and eloquence, defended the cause of liberty and justice in the latter part of the reign of Charles II., when but few warm and able advocates were found on their side in Westminster-hall. See Somers, Lord.

Worcester has long been rendered very interesting, from the circumstance of the Royal Porcelain Works being established within its walls. It is, on our part, a most pleasing duty, not only to trace its rise and progress, but to hold up its elegant and highly-finished productions to the attention of the liberal and scientific. A very material difference exists between this establishment, and others of a similar kind on the continent; as the improvements made by expensive experiments are here effected at the sole charge of the proprietors, while the most famous manufactories on the continent are supported and carried on at the cost of the government of the countries to which they belong. The Worcester porcelain works were founded in the year 1751, by Dr. Wall and a company of proprietors, composed of many gentlemen of fortune and consideration in the city and county; who continued to carry on the concern under those adverse circum-

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flances generally attending the introduction of a new species of manufacture: for at that time little was known of porcelain in England, except by the imports from foreign nations. The Worcester porcelain company had the merit of discovering the method of transferring impressions from engraved copper-plates to the surface of the porcelain. The invention, after a lapse of several years, was conveyed into Staffordshire, and now forms a grand branch of the extensive foreign and home trade carried on in the potteries, giving employment to many thousands. The founders of this manufacture, besides the printing, produced neat enamelled designs, but not very superior either in design or execution. These extensive premises, situate on the banks of the Severn, were subsequently purchased by Meffrs. Joseph Flight and Martin Barr, and by a liberal policy, and great exertion and expense in a long series of experiments, the productions of these works have risen rapidly in the public estimation. His present majesty, the queen, and princecesses, in the year 1788, honoured the manufactory by minutely inspecting its various processes; and at this time the king graciously granted his patent, when these works were styled 'Royal,' being the first that enjoyed this distinction. His majesty condescended to suggest the establishment of a warehouse in London, and one was immediately opened in Coventry-street. The proprietors have since had the honour of receiving a patent and every encouragement from his royal highness the prince regent, the enlightened patron of the arts; and from the late princecess Charlotte, as well as from other members of the royal family, and even from foreign courts; but our limits forbid our entering into detail. From the demise of Martin Barr, esq. in the year 1813, he was succeeded by his sons; and the works are now carried on under the firm of Flight, Barr, and Barr. It is not a little remarkable, that a considerable part of the export trade of the Worcester porcelain works is to our settlements in the East Indies, and even to Canton. We cannot but observe the singular change in our commercial relations in this manufacture; for the Chinees, who twenty years since furnished this country and nearly all Europe with porcelain, are now excluded from our markets, and thrown into the back-ground, and their extensive manufactories nearly ruined. What Wedgwood did in his coarser clays, in his beautiful imitations of the Etruscan vases, and in antique designs on jasper, will long live in the recollection of his country. The same spirit seems to actuate the proprietors of the Royal Worcester Porcelain Works, as they have spared no expense in their finer materials, and highly finished models and paintings, to excel the manufactories on the continent. In these works, the utmost attention is paid to the study of horticultural compositions, landscapes, flowers, &c.; and the success which has attended the new method is most evident, as the productions now fairly rival the best foreign speciments. It is with peculiar pleasure we can at length announce, that we have seen a fabric, recently made by the present proprietors of these works, which, in its colour, fracture, and transparency, is equal to the porcelain made at Sevres or Dresden. This fabric is composed entirely of British materials, and the fact must be the ground of triumph, after all that has been said of the impossibility of finding in this country proper materials for a true porcelain. The process is most curious and elaborate, of which we can but give a flight description, as its details are so numerous. It may be viewed by tickets, granted by order of the proprietors to any respectable individuals leaving their names. The materials, several of which are procured from the county of Cornwall, are first selected with great care, and some undergo a severe calcination previous to their being composed in proper proportions; they are then weighed and mixed, and burnt in a kiln to a very intense degree of heat, and form what is termed a 'frict.' This is ground under a millstone roller previous to an admixture of a certain proportion of the purest argill, or working clay, which is ground with the frit in a mill, the bottom of which is laid with stone, over which large flones of about fifteen hundred or a ton weight are driven by upright 'drivers,' fixed in wooden arms attached to the centre shafts; these, with water, reduce the substance to a thick white liquid, which is afterwards passed through an extremely fine lawn sieve, and is run from calciners into large brick pans, warmed by flues underneath; the heat being sufficient to drive off, by evaporation, the water that cannot be collected on the surface, so that the residuum is a moil clay, which is afterwards tempered in stone vats, and rendered fit for the use of the potter. The man who first brings the rude mass of clay into form, on a circular block, moved horizontally by a boy, who drives a vertical wheel, is called a 'thrower.' The dexterity and rapidity with which the clay appears to spring into the shape required seems like magic, as it is performed silently, and almost unperceived, by the pressure of the fingers and thumb. This mode of 'throwing' differs from the Chinese method, and that practised on the continent, where the thrower moves his block by the action of his feet: in the one he has the advantage of an undivided attention, and the clay is literally obedient to his touch; while in the foreign method, the thrower is distracted with two distinct operations, and at the best it can be but a clumsy exhibition. By this mode all round vessels derive their first formation; any article of an oval, square, or other shape, must be made off a mould formed of alabaster, prepared in a powder, and with water brought into a liquid form, when it is run on the model, and sets quite hard, presenting a case the precise reverse of the model, on which layers of clay, cut to a proper thickness, are pressed with a sponge and the hand, and the artill from this is termed a 'preller.' Great care is requisite in drying the different articles in a stove after they come from the thrower, to render them sufficiently firm to hang on a lathe, where they are reduced to a proper thickness, and a more accurate form, by a turner, who works his wheel on the same principle as one for wood or ivory. It is again committed to the stove, where it is rendered quite dry and crisp; and the surface is afterwards sponged, and then rubbed with paper perfectly smooth. In pieces which have any particular marks or decorations in the clay, they are pressed from moulds, and the handles are attached to the vessel simply by the clay reduced to a liquid form. When burnt, the union is so complete, that it appears to have been made altogether, and is perfectly as firm. We cannot trace the operations in this stage any farther, but are surprised to see how many hands the most simple article passes through, while the risk and labour in thefe and more elaborate specimens are very great in this tender state of the clay. From the potter's stove the ware is carried to what is termed the billet-kiln, and placed in cafes of fire-clay, called feggaris, in which each piece requires particular supports to prevent its yielding to the fire, and losing its proper shape. Here the porcelain is burnt to a incinerate degree of heat, and is rendered quite white and transparent, but has a slight roughness on its surface. From hence it is carried to the warehouse, examined, freed from dust and other imperfections, and then dipped in a liquid termed the glaze, dried in a stove, and afterwards every piece is carefully examined and trimmed; which confils in rendering the surface quite even, and scraping the glaze from the feet, which, if not removed, would melt and adhere to the cafes in which they are burnt.
From the glazing-room the articles are carried to the second kiln, and here they undergo another severe fire, which fluxes the glaze, and gives to the porcelain a beautiful glossy surface. In this kiln the loaves are great, as the porcelain can have no support. It is again warehoused, examined, and delivered to the painters, who decorate it with gold, reduced by a chemical process, so that it may be worked in a liquid form. In paintings of various designs, the outline is made with a black-lead pencil, on the glazed surface, corrected with Indian ink; and the colours, all of which are prepared from mineral substances, worked in oil and spirits of turpentine, are laid on with fine camel's-hair pencils. The colours on this plate are difficult for strangers to understand, as their hues are so surprisingly changed by the action of the fire; while their opaque and obscure appearance is increased at every stage of drying at a common fire, previous to their being burnt in the kiln. The finer kinds of paintings in figures, landscapes, flowers, &c. require repeated burnings, in order to give them sufficient depth and richness by working one tint over another. The enamelling kiln, in which they are fired, is rendered sufficiently hot to fuse the glaze, without occasioning it to run; while the colours, by the aid of their fluxes, are melted into the glaze, so as to render their union perfect, and give them their rich transparent effect.

The durability of these colours, which cannot be acted on by any atmosphere, renders good painting in this style very durable. It has long been a dehideratum with the greatest artists to procure colours for painting on canvas, on which time can have no injurious effect; but in this they have hitherto unfortunately not succeeded, and it was the regret of an eminent artist, that his paintings had not the permanency of porcelain colours. A method of printing, entirely different from the original mode invented by the founders of the works, is now carried on here. (For a description see Painting in Porcelain, in the Addenda.) The last operation is the burning of the gold, which is executed with a fence, black in its external appearance, and remarkable for its hardness and the high polish it takes. This work is performed by women, who render the gold extremely brilliant by rubbing its surface with great care and skill. The enameled gold, for which this manufactory is celebrated, is burnished with a fine file, which is also used in chiseling and in finishing the handles of vases, &c. We have now sketched the process, but we should not omit to mention that in every stage the porcelain is very liable to accident and imperfections; and if not totally spoiled, it may require a repetition of kilns, which much increases the risk and expense. The most costly articles are exposed in the fire from 150 to 200 hours, in their different stages collectively. An important colour used in porcelain manufactory is the rich dark blue, generally called 'royal.' It is prepared from cobalt, and the oxyd of this ore is so powerful as to require the heat of the glaze-kiln to bring out its beautiful tint. It is not, like other colours, worked on a glazed surface, but laid on the porcelain after the first burning, when in the rough or 'biscuit' state, then fired, and afterwards dipped in the glaze, and passed through the glaze-kiln, frequently requiring two or three such degrees of heat to perfect its colour. We were formerly supplied with this mineral from the mines of Saxony, but have now the pleasure to learn that the proprietors of these works have made some successful experiments for a company of gentlemen, who discovered cobalt-ore in Cornwall; which by a particular preparation produces at fine a blue as the Saxon cobalt, and it is now used in preference to the foreign, which can only be imported in the adulterated form of a 'zafer.' The reflection, that by science and labour the rude materials of the earth are raised and converted into elegant and useful forms, and embellished with classical and tasteful designs, is highly pleasing; while it affords the means of maintenance to so many industrious workmen and ingenious artists. All the persons employed in the interring works are 'Brietts,' and this manufactory stands as one proof of the increased civilization of England.


Worcester, the south-eastern county of the state of Maryland, with 16,971 inhabitants, including 4,147 slaves. Snowhill is the chief town. Also, a county of Massachusetts, large and populous, with 50 townships, 53 congregational churches, and 64,910 inhabitants; 50 miles long from N. to S. and 40 broad. Also, a town of the state of Massachusetts, containing 1,577 inhabitants. This is the chief town of a county of the same name, and one of the largest inland towns in the state. It contains two churches, a town-house, and a gaol; 34 miles W. of Boston. N. lat. 42° 10'. W. long. 71° 40'. Also, a township of Vermont, in the county of Chittenden, with 41 inhabitants; 30 miles N. of New Haven. Also, a township of Pennsylvania, in the county of Montgomery, with 868 inhabitants; 18 miles N. W. of Philadelphia. Also, a town of Ohio, in the county of Washington, with 385 inhabitants.

Worcestershire, an inland county in the western part of England, bounded by Herefordshire, which separates it from Wales, on the S.W., by Shropshire on the N.W., by Staffordshire on the N., by Warwickshire on the E., and by Gloucestershire on the S. The form of the county is very irregular, having on every side detached parts surrounded by other counties, and comprehending within its bounds parts belonging to the neighbouring shires. The mean length may be estimated at about 50 miles, and the mean breadth at 25 miles, giving a surface of 750 square miles, or 480,000 acres; but according to the official report laid before parliament, the contents are reduced to 431,560 acres; about two-thirds of the county lie on the E. and one-third on the W. side of the river Severn. Worcestershire comprehends one city, eleven market-towns, three of them parliamentary boroughs, and in all 152 parishes; the whole is distributed into five hundreds. The inhabitants amounted, in 1811, to 160,546, of whom 78,033 were males, and 82,513 females, and the inhabited houses were 50,260.

Historical Events. Worcestershire is supposed to have formed part of the territory of the Cornovii, who also inhabited the contiguous districts of Warwickshire, Staffordshire, Shropshire, and Cheshire. That numerous tribe appear from the Notitia Imperii to have furnished bodies of troops to the Roman armies; but no trace of their name is now to be discovered in the tracts they are believed to have occupied. The county was called by the Saxons Worfceaster, and in Domesday-book Worcestre, and the inhabitants in Bede's time were named Wicci; a term which, in the opinion of Camden, may have been derived from Wicb, signifying, in the old English language, a salt-pit, in allusion to the mines of that substance found in the county. Of the Roman history of Worcestershire but little is known. Ptolemy seems to take no notice of it; nor does it appear to be traversed by any of the roads traced out in the Itineraries of Antoninus. It is highly probable, however, that Worcestershire must have been the theatre of
parts of the exploits of Oftorius, when præfident in Britain; because he was certainly pofted on the Subrina, now the Severn. The other river mentioned by the hiftorians of his operations, the Antonia, has been by fome writers conjectured to be the Avon, which falls into the Severn in the S. part of the county, while others fuppofe it to fignify the Ncn of Northamptonshire. The Roman roads, of which vestiges are discovered in different parts of Worceftershire, although not known to be laid down in the Itineraries, sufficiently prove the county to have profited by the arts and the policy of the conquerors, in the opening of communications; one of the earlieft and moft effectual means of promoting civilization, as well as of eftablishing dominion, among a rude and vanquifhed people. One of thefe ancient or Roman roads is the Rudno-way, or Ridge-way, on the E. fide of the county, running between Worcefter and Alcefter, in Warwickshire: another is a paved way from Kencheffer, in Herefordshire, pointing N.E. towards Worcefter. The great Ikening-street enters the county from Staffordshire, and paffes near Bromgrove: another great road, fuppoled to be the ancient Portway, but now called the King's head-land, paffes over Hagley common. According to Dr. Stukeley, a Roman road extended from Worcefter down the bank of the Severn to Upton, and thence to Tewkesbury on the N. border of Glouceftershire, where it joined Rievieftreetway. Worceftershire formed a part of the Saxon kingdom of Myrcenarie, or Mearc-land, in Latin changed into Merkis. This, by much the larged kingdom of that people in England, was founded by Crida about the year 586, and enlarged by Penda, under whom the Chriflian religion was introduced among the Merkians. During the struggles between the native Britons and their invaders, this part of the country muft have fuffered more severely; but at laft the Britons, driven from the plains, retired behind the Severn into the mountainous tracts of Wales. The ravages of the Danes in the 9th and 10th centuries were not unknown in Worceftershire; and to that people tradition ascribes various federal and military antiquities discovered in it.

During the heptarchy, the greater part of Worceftershire, Glouceftershire on the E. of the Severn, and a portion of Warwickshire, were inhabited by the Witzis, and under the jurifdiction of the bishop of Worcester; but on the accession of William of Normandy, the epifcopal government was fuperfeded, and the civil power eftablihed in the eftablihment of Worcefter. The firit of thefe was Urfo of Abitoth, as he is fyled in Domedlfo-lgue, fon of the lord of that place, in Normandy, and brother of Robert Le Dejenifer, anfeffer of the prefent families of that name in England. Urfo is alfo fyled Vice-comes, having received from the king the hereditary fhirvality, with the confublehip of the castle of Worcefter. He faw in the great councils held in London in the 15th, and in Welfminster in the 18th years of William I. During the conspiracy of Roger, earl of Hereford, and Ralph, earl of Norfolk, he preferved the former from pafling over the Severn to form a junction with the infegants. His daughter and heirefs, Emmeline, married Walter, the progenitor of Beauchamp, whose family afterwards became earls of Warwick. The firit earl of Worcefter was Wallefer de Mellent, a relation of the royal family. He held afo the paternal honours in Normandy; but fiding with the barons againft Henry I., his eftates were laid warf, himfelf long held a prifoner, and even when enlarged not eftablihed with the keeping of any of his own caftles. Taking part with Stephen againft the emperes Mauf, his city of Worcefter was carried by affallant, and reduced to ashes. Dying a prifoner in Normandy, his fon inherited the Norman but not the Englifh honours. All this happened in the 13th century; and the title of earl of Worcefter seems to have lain dormant until 1297, when it was conferred on Thomas Percy, fon of Henry, lord Percy, by his firft wife Mary, daughter of Henry Plantagenet, earl of Lancaster, and brother of Henry I., earl of Northumberland. This gallant earl of Worcefter, accompanying the Black Prince to France, &c. diftinguifhed himself under the command of John of Gaunt, duke of Lancafier. The title in 1420 was befown on Richard Beauchamp, of the house of Warwick, defcended from the firft Norman sheriff or earl. He ferved with great reputation in France; but dying in 1449 without male issue, the title was granted to John Afibett or Tiptoft, baron of Powys. Under Henry VI. he was charged with the guard of the narrow seas, and appointed lord-deputy of Ireland; and by Edward IV., judge of North Wales, confidtr of the Tower of London, and treasurer of the exchequer. Soon after he became chancellor of the kingdom, blind, however, retaining his command at sea. It was not in military and state affairs alone that this nobleman diftinguifhed himself. Educated at Oxford in all the learning of thofe days, he afterwards visited Jerusalem for devotion; alfò Padua, Venice, and Rome, to confult the libraries and the learned focieties of thofe places; and was the author of feveral works. On the temporary eftablihment of Henry VI. by Neville, earl of Warwick, the earl of Worcefter was apprehended and beheaded at London in 1471. His fon was afterwards replaced in the family honours and eftates by Edward IV., but dying without issue in 1485, the title was given to Henry VII., the fon of Charles, natural fon of Henry, duke of Somerset. His grandfon, Henry, was created marquis of Worcefter by Charles I.; and his grandfon, Henry, was, in 1632, by Charles II., created duke of Beaufort, the title of marquis of Worcefter being by courtesy attached to the earl of that family to the prefent time.

State of Property.—Prior to the Norman Conqueft, great part of the lands of Worceftershire belonged to the church; but on that event much was beftowed on the favourites and followers of the Conqueftor. Very little is now pofted by the descendants of the ancient proprietors; for in the various revolutions of the kingdom, the adherent of the longeving sovereigns were in general deprived of their property. William Beauchamp, baron of Emley, pofted great eftates by deferent from the firft earl of Worcefter; but loft them by adhering to the emperes Maud againft Stephen. They were reftored however by Henry II. In the contests between king John and the barons, the grandfon of William Beauchamp was a materia suffrager; for having taken the fide of the nobles, the church of Worcefter, on the re-eftablihment of John's power, laid hold of the opporlunity to enlarge their precincts, abridging the accommodations of the caftle, fo that it was no longer fit for the habitation of the eftablishment and its retinue; and from that time it began to fall into decay. The whole county was then the property of, or pofted by ecclefiaftics, and by a few barons; nor was it until a much later period that a more general division of lands, from various caufes, took place. In the reign of Richard II., the Beauchamps, earls of Warwick, were again deprived of their lands: under Henry VII. other large poftfiores of land, who had borne arms in Bosworth-field, were friped of their property. But the greatfeft forfeiture of lands in Worceftershire took place in confequence of the attaider and execution of Edward, earl of Warwick, who had taken the part of Perkin Warbeck againft Henry VII. Considerable changes were also occasioned by the transfer under Henry VIII.
the lands of the dissolved religious establishments, to his favourites and the nobles who co-operated in his schemes. In the unhappy reign and life of Charles I., Worcestershire was often the theatre of warfare; many estates were dismantled or ruined, and but few really acquired; for the prices set on the church-lands by the parliamentary surveyors were so enormous, that though sold at nominally a few years value, the purchasers generally lost by the acquisition. In later times, the changes of property in this county have been numerous and frequent; but the causes of those changes depending on private motives and not on public interests, as in former days, they do not come within the scope of this article. It is, however, worthy of remark, that out of the great number of families who recorded their armorial bearings, on the first visitation of the county by the Clarendon, King at arms, in 1533, only six or seven now remain, and of these only two reside on the ancient family estates. Of those named in the last visitation (1695) but few descendants now exist. By these changes, however, it has happened in Worcestershire, as in other districts where manufactures and commercial enterprise prevail, that the landed property is now distributed amongst a much greater number of proprietors, and that the country is incomparably better peopled and cultivated than in former times.

General Aspect, Soil, and Climate.—When viewed from any of the numerous surrounding eminences, Worcestershire assumes the aspect of a plain, the gentle slopes and risings on the east and west of the capital being then scarcely discernible. From these eminences also the cultivation of the plains is viewed to great advantage, as there are no tracts of considerable extent so barren or so neglected as not to present an agreeable as well as profitable verdure. On a nearer view, from a hill in the centre of the county, to the easterly part of the capital, a most beautiful landscape presents itself; the whole back-ground, distant from eight to twelve miles, appears to be the continuation of one range of hills, enclosing rich and beautiful plains, in which the flourishing hop-gardens and plentiful orchards constitute very interesting and gratifying objects.

The soil of the county is various; but chiefly consists of rich loamy sand, mixed with a small proportion of gravel, in the central parts on the north of Worcesters. Towards the east the soil is a very light sand, containing a few spots of clay, and some peat-earth; but on the eastern district of the county is, in general, a strong clay, the wale lands being principally a dark black peat-earth. Between Worcesters and the vale of Evesham, in the south-east part of the county, the soil is partly red marl, and partly brown clay, whilst the subsoil in some places is composed of limetone. In the celebrated vale of Evesham, watered by the river Avon, the soil is particularly deep, of a darkish earth, resting on clay, and in parts on gravel. Further north lime-flints prevail, in the upper lands, on the skirts of the Cotswold hills, and a rich loam in the lower lands. In the south-west division of the county, between the Severn and the Malvern hills, the soil is in general clay, mixed with sand and gravel; but farther to the northward the gravel increases, until it terminates in the light sands of the northern border of the county. In all of these districts, however, one rocky and stony soil is found; but according to Mr. Pomeroy, in his Agricultural Survey, no traces of chalk or limestone occur; nor have any been found, it is said, in the lime-quarries. In all the Severn is described by Mr. Pitt, in his subsequent survey of the county, to contain probably ten thousand acres of a deep rich sediment, deposited in the course of ages by the river and its tributary streams. In some parts, this sediment consists of a pure water-clay, fit for brick-making, but generally of a rich mud, fertile and favourable to vegetation. The county has been lately distributed in the following manner:

<table>
<thead>
<tr>
<th>Description</th>
<th>Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common fields of arable land</td>
<td>20,000</td>
</tr>
<tr>
<td>Inclosed ditto</td>
<td>43,500</td>
</tr>
<tr>
<td>Permanent grass-land</td>
<td>100,000</td>
</tr>
<tr>
<td>Kitchen-gardens, &amp;c.</td>
<td>5,000</td>
</tr>
<tr>
<td>Woods, wales, rivers, roads, &amp;c.</td>
<td>35,000</td>
</tr>
</tbody>
</table>

Whole county about 500,000

Respecting the corn-produce of the county, it is thus estimated in Pitt's survey: In 360,000 acres of arable land, 43,500 are supposed to be laid down in wheat, yielding from 20 to 32 bushels per acre, or 1,400,000 bushels on an average. From this quantity deducting 168,750 bushels, at 2½ per acre, the remaining net produce is 1,091,250 bushels.

The climate of Worcestershire, particularly in the middle, southern, and western parts, is liable to be remarkably mild, soft, and healthy. The vale of the Severn rises but little above the sea, and the valleys of the Avon and Teme are nearly on the same level; and the adjoining uplands, seldom rising at the most 150 feet higher, possess a warmth and softness which ripen the grain and bring to perfection the fruits of the earth, from a fortnight to a month earlier than in more elevated counties, even enjoying a similar soil and surface. The principal bleak and inclement parts are the Bredon and Broadway hills on the south of the county, and the Lickey range on the north; for the Malvern hills on the west, although only sheep-pasture, possess a most salubrious climate.

Hills.—The highest hills are certain points of the Lickey range, which, rising to the north-east of Bromgrove, runs north towards Hagley, and diverges to the eastward. Some of these points are elevated to 800 or 900 feet above the general level of the country. On this range is a small spring producing two streams, one of which flows northward to the Rea, which falls into the Trent, and with it is discharged into the German ocean on the east side of the island; the other, falling into the Stour, is carried by the Severn into the Bristol Channel on the west. Bredon-hill, in the south-east corner of the county, is of about equal elevation. The highest point of the Malvern range of hills, called the Herefordshire beacon, rises, according to the great ordnance survey of England, 1444 feet above the level of the sea: the Worcestershire beacon, barometrically measured, rises 1298 feet; and North-hill 1211 feet above the Severn.

Rivers.—These are, the Severn, the Avon, the Teme, and the Stour; the smaller streams are, the Salwarp, Arrow, Ledden, Rea, &c. The Severn, called by the Romans Sabrina, is supposed to be so named from the Britth terms sābrinā, sand, or sābrinā, sandy, because it is often turbid, especially when heavy rains fall on the Welsh mountains. See SEVERN.

The river Avon is said to have been originally so named by the Britons, on account of the gentleness of its course. It is commonly distinguished from a number of other rivers in Britain by the same name, as the Warwickshire Avon, and will be ever memorable while the name of Shakspere remains. Entering Warwickshire towards the south-east corner, the Avon, by a winding course, waters the vale of Evesham, passes by Pershore, and unite with the Severn in the neighbourhood of Tewkesbury. It is navigable for barges
barges through the whole extent of the county, by means of locks in different places. See Avon.

The Teme, rising in Radnorshire, enters Worcestershire a little above Tenbury, and thence pursuing a winding but rapid course, through a succession of beautiful and romantic scenery, along the woods and dales of Stanford, the seat of Sir Edward Winnington, bart., it is lost in the Severn below Worcester. From the declivity of its bed, and consequent rapidity, it is navigable for barges only up to Powick bridge, a mile and a half from the Severn. But although on this account the Teme be of little commercial use, it is peculiarly ornamental to the county, no part of which furnishes the banks of this stream in variety of ground, wood, and open lawn. A ramble along its various windings, extending upwards of twenty miles, through a succession of orchards, hop-gounds, corn and pasture land, is, in autumn, peculiarly agreeable. The Stour, an inconsiderable stream, has risen into notice since the opening along its course of the important canal by Kidderminster, uniting the Severn and the Mersey. The Salwarp pursues its short course to the Severn by Bromsgrove and Droitwich, where it formerly received the overflows of the salt-springs, but these are now turned into the new canal from that town to the Severn. The other little streams of Worcestershire merit no particular notice.

Canals.—Connected with the natural rivers are the artificial canals opened throughout the county. These are, the Trent and Severn, or the Staffordshire and Worcestershire canal, more commonly called the Stourport canal, from the place where it falls into the Severn, eleven miles north from Worcester; the Droitwich canal, for the conveyance of the produce of the salt-springs to the Severn; the Worcester and Birmingham canal; the Dudley extension canal; and the Leominster canal, near Tenbury. See Canals.

Woods and Forests.—About the time of the Norman Conquest, Worcestershire was considered to possess five forests; namely, those of Feckenham, Ombersley, Horewell, Malvern, and Wyre; but of the last only a small portion lies within the county. Feckenham forest, once very extensive, has now almost disappeared, owing to the continual demand for fuel to the salt-works at Droitwich, until of late years a sufficient supply of pit-coal has been obtained. Ombersley forest, on the north of Worcester, and Horewell forest on the south, have long been deforested. Malvern forest or chaise extended between the Severn and the summit of the hills of the same name, where many will be traced the trench which divided the forest and the county from Herefordshire on the west. Wyre forest, on the north border of the county, now more properly belongs to Shropshire and Staffordshire. Besides the vetiges of these forests, the county contains several tracts of woodland, of oak, elm, and beech; but from the demand for young trees to make hop-poles, and for trees to be converted into charcoal for the iron-works, in the neighbouring counties, much timber of superior size cannot now well be expected in Worcestershire.

Mineralogy.—The minerals of this county are neither numerous nor particularly valuable. Clay and lime-stone are abundant; but coal, to render the latter useful in agriculture as well as building, is not easily procured where the stome is found. Some coal is indeed railed in the north-west district, about Mamble, where is a rail-way leading to the Leominster canal. Coal is also found at Penfax, and the Whitley-hills, in the same quarter, and is much used for coke for the hop-kilns and lime-pits; but the vein is too thin to promise much advantage to the county at large, which is principally supplied from the Staffordshire mines, by means of the Severn. In the vale of Evesham, and many other parts of the county, fuel is particularly scarce and dear. The lime-stone quarries about Dudley are very extensive, and extremely curious excavations: but although the town stands in a detached part of the county, included by Staffordshire, those quarries actually belong to the latter county. Building-stone of different sorts is also found in several parts. But the principal mineral riches of Worcestershire arise from the salt-mines of Droitwich, a parliamentary borough, situated five miles north-east from Worcester, on the road to Birmingham. These salt-works are of great antiquity, having been granted by Kenilworth, king of Mercia, to the church of Worcester, in 816; and it appears from Domelad-book, that shares in them were annexed to many estates at even a considerable distance, on account probably of the wood they yielded for the manufacture of the salt. The principal brine-pits, however, belonged to the crown, but were granted by king John to the burgesses of Droitwich. The general subfratum of the environs of the town is supposed to be a salt-rock, lying usually from 150 to 200 feet below the surface. On boring in any part, the salt-springs are met with about 110 feet below the surface: the boring-machine then passes through about 150 feet of gypsum to the brine-riber, in depth about 22 inches, beyond which is a bed of salt-rock hitherto unexplored. In searching for this brine-riber some years ago, the miners paddled through four feet of moulage, 32 of marle, 40 of gypsum, a brine-riber of 22 inches, and 75 feet of another stratum of gypsum, below which they came to the salt-rock. (See Droitwich and Salt.) For an account of the mineral waters of Malvern, see that article; and more particularly the paper of Mr. Horner, in the first volume of the Geological Society of London. Besides these, Worcestershire has some chalybeate springs at Sandbourne and the Round-hill, in the parish of Kidderminster.

Manufactures and Commerce.—The commerce of Worcestershire is considerable, from its own productions, and from the deposit and transit of those of the neighbouring mining and manufacturing districts. Of its own products may be noticed the hops, fruit, cider, and perry, which render the capital the principal mart for those articles in the western parts of the kingdom. The county also exports a considerable surplus of its own manufactures, consisting of Kidderminster stuffs and carpets; of Worcester gloves, china and glass-ware, and of nails, bar and sheet iron. Great quantities of salt are annually lent from Droitwich; Evesham furnishes oil and oil-cake; timber, gras-feeds, corn, flour, malt, salmon, cattle, and sheep, and other agricultural products are furnished by the county in general.

Civil and Ecclesiastical Divisions.—Worcestershire is divided into five hundreds; viz. Ofalvideley, Halfshire, Dodgington, Pershore, and Blackenheim: the first containing the capital and the centre of the county, with several detached portions in other quarters; the second occupying the north-west part; the third, the north-east; the fourth, the south; and the fifth, the south-east quarter, around Evesham. In ecclesiastical matters, the county is under the government of the bishop of Worcester, and contains 152 parishes. The diocese was formerly of great extent; but in 1541 the see of Gloucester, and in 1542 that of Bristol, being erected, a considerable part of the episcopal jurisdiction of Worcester was withdrawn. At present the bishopric comprehends all the county, with the exception of 15 parishes and 8 chapels belonging to Hereford; about one-third part of Warwickshire, together with the parishes of Brome and Clent in Staffordshire, and Hales-Owen in Shropshire. The dioce thus contains 116 rectories, 79 vicarages, 26 curacies, and 41 chapelleries, all distributed into 9 deaneries.
Parliamentary History.—Worcestershire has been represented in parliament ever since the third year of Edward III., and at and ever since the revolution has maintained a respectable character for independence in the choice of its representatives. In the early part of the last century, Sir John Pakynston accused the bishop of interfering in the election, of forbidding the clergy to vote for Sir John, of threatening the tenantry of the fee not to renew their leases if they voted for him, and even of defiring the baronet to withdraw his pretensions. The charges were established; and after a long contest between the two houses of parliament, on an address to queen Anne, the bishop was dismissed from his office of almoner. Worcestershire, which is included in the Oxford circuit, sends nine members to parliament; viz. two for the county, two for the city of Worcester, two for each of the boroughs of Droitwich and Evesham, and one for the borough of Bewdley.

Manors and Country seats.—Of these, Worcestershire contains a very considerable number, some of which are highly deserving of notice. Hagley-park, the "British Temple" of Thomson, the favourite seat of the ingenious and amiable lord Lyttelton, the historian of Henry II., is situated toward the northern frontier of the county. The grounds have long been celebrated for variety and beauty of scenery. Croome-court, the handsome seat of the earl of Coventry, eight miles to the south of Worcester, is more indebted to modern art and skill for its beauties than to the natural features of the ground. The agricultural improvements, chiefly carried on by the late earl, are both extensive and important. Six miles north from Worcester is Ombreley, the residence of the marchioness of Downshire, in the midst of spacious grounds. The house has been lately modernized. Grafton-hall, about a mile west from Bromsgrove, the property of the earl of Shrewsbury, was in ancient times a capital manor; but being burned down in 1710, the porch and a part of the hall alone remain as specimens of its original magnificence. The latter has been converted into a chapel for a modern building annexed. Madresfield, six miles south-west from Worcester, the residence of vicount Beauchamp, is an ancient baronial castle, greatly altered in the modern style. Whitley-court, the seat of lord Foley, eight miles north-west from Worcester, is a highly improved and spacious mansion, in the midst of an extensive park. The parish-church, closely adjoining to the house, is one of the most elegant in the kingdom. Annexed to the seat of Worcester is the ancient castle of Harlebury, the residence of the bishops from the time of Henry III., situated between nine and ten miles north from Worcester. The principal part of the buildings, as they now stand, is the work of bishop Hough. Much of the improvements, however, are due to the late bishop Hurd, who furnished the palace with a valuable library, for the use of his successors in the see, in which are the principal books from the libraries of Mr. Pope and bishop Warburton.—Collections for the History of Worcestershire, by the Rev. Tredway Nah, D.D. 2 vols. fol. Lond. 1781-2. Supplement to ditto, ditto, 1799. General View of the Agriculture of the County of Worcester, by William Thomas Pomcory, 4to. Lond. 1794. General View of the Agriculture of the County of Worcester, by W. Pitt, 8vo. Lond. 1815. Beauties of England and Wales, Worcestershire, by F. C. Laird, 8vo. Lond. 1816.

WORCUM, or Woudrichecum, or Wodescum, a town of Holland, situated on the south side of the Wałah, first surrounded with walls in 1460, and defended with four bastions; 13 miles E.N.E. of Dort.

WORCUM, a sea-port town of Frieland, situated in a fertile country, but subject to inundations of the sea, especially when the wind blows from the east. The harbour is blocked up with sand, but it carries on a considerable trade by means of its canals; 18 miles S.W. of Lewarden. N. lat. 53°. E. long. 5° 35'.

WORD, in Language, is an articulate sound, designed to represent some idea.

Word, in Writing, is an assemblage of several letters, forming one or more syllables, and signifying some thing.

The Port-royalists define words to be distinct articulate sounds, agreed on by mankind for conveying their thoughts and sentiments.

The proper character of a word, according to the ingenious Mr. Harris, is that of its being a found significant, of which no part is of itself significant; and hence he infers, that words are the smallest parts of speech.

The first and most obvious distinction of words is into such as are significant absolutely or by themselves, and such as are significant by relation: the former may be called principals, and the latter accessories. Moreover, all words whatever, significant as principals, are either substantives or attributives; and those, which are significant as accessories, acquire a significancy either from being associated to one word, in which case they only define and determine, and may jolly be called definitives, or to many words at once, in which case they serve to no other purpose than to connect, whence they are called connotatives. Accordingly, Mr. Harris refers all words to these four species. Hermes, p. 20, &c. See Speech.

Grammarians divide words into eight classes, called parts of speech; which are, the noun, pronoun, verb, participle, adverb, conjunction, preposition, and interjection; to one or other of which, all the words and terms in all languages, which have, or may be invented to express our ideas, are reducible. See each.

Words, again, are divided into primitives and derivatives, negative and positive, simple and complex, common and proper, abstract and concrete, synonymous and equivocal.

With regard to their syllables, words are further divided into monosyllables and polysyllables.

The grammatical figures of words, which occasion changes in the form, &c. thereof, are, syncope, apocope, apostrophe, diacrit, aphanesis, profthesis, openthesia, paragoge, metathesis, &c. See SYNCOPE, APOCOPE, &c. See also Figure.

The use of words, we have observed, is to serve as sensible signs of our ideas; and the ideas they stand for in the mind of the peron that speaks, are their proper significations.

Simple and primitive words have no natural connection with the words they signify; whence there is no rationale to be given of them; it is by a mere arbitrary institution and agreement of men, that they come to signify any thing. Certain words have no natural propriety or aptitude to express certain thoughts, more than others: were the cafe, there could have been but one language.

But in derivative and compound words the cafe is somewhat different. In the forming of these, we see a regard is to be had to agreement, relation, and analogy: thus more words that have the same ending, have one common and general way of denoting or signifying things; and those compounded with the same prepositions, have a similar manner of expressing and signifying similar ideas in all the learned languages where they occur.

For the perfection of language, it is not enough, Mr. Locke observes, that sounds can be made signs of ideas; unless these can be made use of, so as to comprehend several
Words of Command. See Exercise.

Word, Watch-Word, in an Army or Garrison, is some peculiar word or sentence, by which the soldiers are to know and distinguish one another in the night, &c. and by which spies and designating persons are discovered.

It is used also to prevent surprizes. The word is given out in an army every night by the general, to the lieutenant, or major-general of the day, who gives it to the major of the brigades, and they to the adjutants; who give it first to the field-officers, and afterwards to a serjeant of each company, who carry it to the subalterns.

In garrisons it is given, after the gate is shut, to the town-major, who gives it to the adjutants, and they to the serjeants.

Word, in Heraldry, &c. See Motto.

Words, Defamatory, Treasable, &c., in Law. See Defamation, Scandal, and Treason.

WORDEN, in Geography, a town of the duchy of Holstein, on the right side of the Elbe; 10 miles N.W. of Glückstadt.

WORDEN, Greffen, a town of the duchy of Bremen; 10 miles N.N.W. of Stade.

WORDERNBERG, a mountain of the duchy of Stria; 6 miles S.S.E. of Eifenhartz.

WORDINGBERG, a sea-port of Denmark, situated on the south coast of the island of Zealand, opposite the island of Falster. In the year 1066, Waldemar I. built a strong castle here, which is now gone to decay. Waldemar III., who was exceedingly fond of this place, resided here for the most part; and in derision of the Hanse towns, built the well-known tower, which, from a golden groce erected on the top of it, he called Cans, that is, The Goose. In this tower, he purposed to confine the prisoners of the Hanse towns that should fall into his hands in the war he intended to carry on against them. As the old castle gradually fell to decay, prince George, who was brother to Christian V., and married to Anne, queen of England, built here an entire new castle, which Frederick IV. afterwards enlarged; but that edifice has been pulled down. The usual palaige to the islands Falster and Lolland is from this place. In 1240, at a famous diet held here, the Old Jutische Low-buck, or Codex Legum Juricarum, was compiled and promulgated: this body of laws is still in force in South Jutland. In 1256 another diet was held here; and in 1658, preliminaries for a peace between Denmark and Sweden were treated of in this town; 43 miles S.W. of Copenhagen. N. lat. 55° 3'. E. long. 11° 58'.

WORE. See Wyre.

WORENZUTTE, a town of Pruflen, in Ermeland; 8 miles S. of Heilberg.

WORGAN, Dr. John, in Biography, a musical graduate of Oxford, organist of St. Mary-Axe, Bedford chapel, and many years a distinguished performer on the organ at Vauxhall, and Dr. Arne's successor there in the composition of cantatas, songs, and ballads.

He learned the rudiments of music of his elder brother, who had likewise an organist's place in the city, and played the violoncello in the Vauxhall band. Their scholars on the harpsichord were very numerous, particularly within Temple-bar; and John, as an organist and opening of new organs, rivalled Stanley. He was a very studious man, and dipt very early into the old ecclesiastical compositors of Italy. He succeeded Gladwin in playing the organ at Vauxhall. His first study in composition and organ-playing was directed by Reesgrave, who pointed his attention to the pure harmony and modulation of Palestrina, and organ-fugues of Handel. His constant use of the organ at Vauxhall, during the summer,
summer, ranked him with Stanley and Kceble; and his enthu-asm for Scarlattii's lessons, with which he was impressed by Rofeingrave's, rendered him equal to Kelway in their execution.

With an extempore prelude, alla Palkrina, and one of Handel's organ-fugues, he used to preface his concerto every night.

At length he got acquainted with Geminiani, fuore by no other divinity, and on consulting him on the subject of composition, he was told that he would never be acquainted with all the arena of the science, without reading "El Porque della Muñeca," a book written in Spanish by Andre Lorente, en Alcala, 1672. But where was this book to be had? Geminiani told him, and told him truly, that the tract was very scarce. He had, indeed, a copy of it himself; but he would not part with it under twenty guineas.

Worgan, on fire to be in possession of this oracular author, immediately purchased the book at the price mentioned; not understanding a word of Spanish, he went to work in learning it as eagerly as Rowe the poet, when lord Oxford had expressed a wish that he understood that language, which Rowe thought would qualify him for a good place under government. But after hard drudgery, when he hasted to acquaint the minister of state that he thought himself a tolerable master of the Spanish tongue, "I give you joy (says lord Oxford); you are now able to read Don Quixote in the original." The knowledge of Spanish and study of Lorente seem to have had no other effect on Worgan's compositions, than to spoil his Vauxhall fongs; which though sung into popularity by dint of repetition, had no attractive grace, or pleasing caft of melody.

He composed several oratories, in which the chorusses are learned, and the accompaniments to his fongs ingenious. The cantilena was original, it is true, but it was original awkwardness, and attempts at novelty without nature for his guide.

His organ-playing, though more in the style of Handel than of any other school, is indeed learned and masterly, in a way quite his own. In his youth, he was impressed with a reverence for Domenico Scarlatti by old Rofeingrave's account of his wonderful performance on the harpsichord, as well as by his lessons; and afterwards he became a great collector of his pieces, some of which he had been honoured with from Madrid by the author himself. He was the editor of twelve at one time, and fix at another, that are admirable, though few have now perseverance sufficient to vanquish their peculiar difficulties of execution. He is still in possession of many more, which he has always locked up as Sybil's leaves.

He had the misfortune to labour under two dreadful calamities; a bad wife, and the flone. He got rid of the former, after great mortifications and expense, by divorce; but in too early wishing to abridge his sufferings from the latter, he lost his life in the torture of an operation, August 20, 1790.

WORGAUM, in Geography, a town of Hindooftan, in the country of the Mahrattas; 20 miles W. of Poonah.

WORK, in the Manage. To work a horfe, is to exercise him at pace, trot, or gallop, and ride him at the manege.

To work a horfe upon volts, or head and haunches in or between two heels, is to passe him, or make him go sideways upon parallel lines.

To work, in Sea Language, is to direct the movements of a ship, by adapting the sails to the force and direction of the wind. A ship is also said to work when the strans and labours heavily in a tempestuous sea, so as to loosen her joints or timbers. See Rolling.

WORK, Carpenter's, Clock, Crown, Field, Fire, Fret, Gratufine, Horn, Mosaic, Out, Regimen of the, Ruffis, Scratch, Stream, Verrnacular, and Wax. See the several articles.

WORK, Diftcharge, in Calico-Printing, &c. a peculiar kind of proces, in which the cloth is first dyed of some uniform colour, by means of a mixture of iron-liquor and some one or more of the common vegetable dyeing substances; and calicoes thus prepared are said to be dyed of self-colours. There is then washed and dried, and when properly pressed or calendered, they are fit for receiving any pattern, according to the views of the artist. This operation is generally effected by means of the mineral acids, previously fitted for the purpose by dissolving in them a portion of one or more of the metals, according to the nature of the dye which is intended to be dissolved, or of the colour to be produced. In doing this, the discharging liquor should be so made as to be capable of dissolving the iron which is contained in the dye, and which is always used in quantity sufficient for covering, or at least diffusing in a great measure, the other colour or colours which had been employed with it, and at the same time for acting as a mordant in beautifying and fixing those colours. Thus a piece treated with a decoction of Brazil-wood, and dyed black by being padded with iron-liquor, if when dried it be printed with a peculiar solution of tin, the ferruginous portion of the dye will be dissolved, and the printed part will be instantly converted from a deep black to a brilliant crinmon. The term padding denotes the operation of paffing the pieces from a roller through a trough containing a solution of iron, or any other mordant, and is synonymous with blotching. In the fame way, an olive-coloured calico, dyed in a solution of iron and a decoction of weld, will be as speedily changed to a bright pale yellow; and the various drabs and flates of every shade which have been in their composition, will undergo as sudden a change by the same treatment; though the colour of the figures produced upon them will depend on the materials with which the cloths were originally dyed. Even the deepest gold colours, or strongest buffs, if produced by iron only, may, by a peculiar preparation of tin, be discharged; and those parts of the cloth which have been treated with this metallic solution, will be restored to their former whitenefs. Calicoes also, dyed of a light blue in the indigo-vat, then padded through gumach and copperas, and finifhed in a bath of querciton bark and alum, may have figures of a bright green imparted to them. In this cafe, the green is originally formed by means of the indigo-vat and the bark, though it is enveloped by the iron of the copperas, which overcomes the other colours, till the solution of the tin is applied, which removes the iron from those particular parts, and gives a brilliancy to the remaining colour, which they would not otherwise have possessed; the tin being a powerful mordant for the bark, by which the yellow of the green is procured. A good self-colour may likewise be given to calicoes, merely by dyeing them in gumach and copperas, and then running them through an alkaline solution of annatto; and here the figures produced by the application of a colourless solution of tin will be of a bright orange.

In the instances above cited from Mr. Parkes's Essays, vol. ii., he refers only to that branch of discharge-work in which all the purposes are attained by dissolving the iron that makes a part of the colour intended to be discharged; whereas the finer and more expensive work is done by a different process. The particular kind of chemical discharge-work
work above-described issubject to the imperfection of not being perfectly flat; that is, the goods thus produced will not bear frequent washing, like those which are done by the bath of madder or bark. In this connection with permanent colours, Mr. Parke is led to mention a very valuable green, not long ago invented by a Mr. Wall of London, secured to him by patent, which was produced by printing ground indigo, mixed with a peculiar kind of solution of tannin, and then softening the indigo within the fibres of the calico, by means of that procera denominated China-blue dipping. (See Dipping.) After this, the goods are to be dyed in a copper of bark or weld, which converts the blue into a green, and the whites are to be cleaned by croft-bleaching, &c.

In another kind of discharge-work, the agent that is employed is the citric acid, in various degrees of concentration, according to the purpose to which it is to be applied, or the strength of the ground intended to be discharged. This is employed chiefly for the production of white figures upon self-coloured grounds produced by madder and sundry other dyes. The acid for this purpose is mixed with either gum or paste to a proper consistency for the black, the plate, or the cylinder, and from thence it is transferred to the piece; and wherever it attacks, the mordant, whether iron or alum, is discharged, and a delicate white appears in its stead. In using citric acid for this purpose, a portion of one of the mineral acids is sometimes mixed with it. There is another species of discharge, on which the agent employed by the printers is the nitrous, and sometimes the nitro-muriatic acid. See Discharging of Colour and Colour.

WORKALLEN, in Geography, a town of Prussia, in Oberland; 4 miles S.W. of Liebigstadt.

WORK-HOUSE, a place where indigent, vagrant, and idle people are set to work, and maintained with clothing, diet, &c. See House of Correction.

Such are the Bridewells, and several other places about the city of London, or suburbs; such also was the foundation of that in Bihopgate-street, for employing the poor children of the city and liberties, who have no settlement; and that for the parishes of St. Margaret's, Wettminton, called the Grey-coat hospital.

By 43 Eliz. cap. 2, the church-wardens and overseers, with the consent of two justices, are empowered to set to work the children of the poor and other delinquent persons, and to provide for the relief of the lame, old, blind, and such as are poor, but not able to work; and they may erect, with the leave of the lord of the manor, on any waste or common, of which the parish is parcel, convenient houses of dwelling for the poor. (See Poor.) By 3 Car. IV. they may set up and use any trade, merely for the employment and relief of the poor. By 9 Geo. cap. 7, they may contract for the maintenance and employment of the poor in houses purchased or hired; and poor persons refusing to be lodged and maintained in such houses, shall be put out of the parish-books, and not entitled to receive relief from the church-wardens and overseers; and two or more parishes are allowed to unite in lodging their respective poor in one house; and the officers of one parish are allowed to contract with those of another for the maintenance, &c. of their poor. Moreover, by 8 & 9 Will. cap. 30, parish poor that are relieved are required to wear on the shoulder of the right sleeve of the uppermost garment, in red or blue cloth, a large Roman P, together with the first letter of the name of the parish or place to which they belong. By 24 Geo. I. cap. 43, no spirituous liquor shall be sold or used in any work-house, or house of entertainment for parish poor. The statute 22 Geo. III. cap. 83, establishes many new regulations with regard to the maintenance of the poor; but leaves it optional in any parish or place whether they will adopt these, or retain the present mode. At Amsterdam they have a famous work-house, or house of correction, called the Raaphuyse, (which fees,) which, by a privilege granted in 1622, has alone the right of having and cutting the dyer's woods, as brasil, fanta, campechey, fassafras, &c. Each person tolerably strong, kept in the house, is obliged to furnish about two hundred and fifty pounds of rasped wood per day; and the weaker, a certain proportionable quantity of chips.

WORKING Furnace. See Furnace.

Working Glass. See Glass.

WORKINGTON, in Geography, a considerable market and sea-port town in the ward of Allerdale-above-Derwent, county of Cumberland, England, is situated on the borders of the river Derwent, at the distance of 34 miles S.W. by W. from Carlisle, and 310 miles N.W. by N. from London. The manor was anciently possessed by the Culwens, now Curwens, a family of great consequence in the county, of whom eight out of ten, in succeflive descent, were knights of the shire. The present importance of the town has originated from the working of the collieries since the reign of queen Elizabeth, at which period the entire maritime strength of the county consisted of only twelve vessels, though the number now belonging to this port alone is more than 160, and many of them are from one to three hundred tons burthen. These are principally engaged in the exportation of coals to Ireland, and some few to the Baltic. The river is navigable to the town for ships of four hundred tons; and on each bank, near the mouth, are piers. The harbour is one of the safest on the coast; and many improvements have been recently made in the situation and construction of the quays. The appearance of the town is diversified; several of the ancient streets are narrow and irregular; those of modern erection are better formed; the public buildings are all of late date. The houses are principally disposed in two clusters: in that called the Upper Town a new square has been erected, in the area of which is the corn-market; at a little distance are the butchers' shambles. The church, a neat edifice, contains the monument of Sir Patrick Curwen, baronet, who died in 1661. In the town are meeting-houses for Presbyterians and Methodists, and a Catholic chapel; also a theatre and an assembly-room. Two large weekly markets are held on Wednesdays and Saturdays for meat and other provisions. Corn is sold only on the Wednesdays, which is the principal market-day. Here are also two annual fairs for cattle, but of no great note. The principal manufactures are those of sail-cloth and cordage, and every thing connected with shipping. Vessels of from four to five hundred tons, copper-bottomed, are built here, and sold to the merchants of Liverpool, Cork, &c. In the population return of the year 1811, the town of Workington is stated to contain 1059 houses, and 5897 inhabitants. The parish includes the townships of Great Clifton, Little Clifton, Stainburn, and Winifales, making an addition of 726 to the population, and of 161 to the number of houses.

On an eminence, near the east end of the town, overlooking the river Derwent, is Workington-hall, the seat of John Chriftian Curwen, Esq., who has nearly rebuilt it, from the designs of Mr. Carr of York, and greatly extended and improved the park and pleasure-grounds. The old manor,
manion, of which there are scarcely any remains, was cated-
tellated, pursuant to a licence granted by Richard II. to
Sir Gilbert de Culwen in 1379. Mr. Gough observes, that
the walls were so remarkably thick, that in making some
recent improvements, a passage was excavated through one
of them lengthways, leaving sufficient thickens on each
side to answer every purpose of strength. In this manion,
Mary, queen of Scots, when she landed in England in
1568, was hospitably entertained by sir Henry Curwen,
till he was required by queen Elizabeth to resign his royal
prerogative, who was removed to Cockermouth castle, and
afterwards to that of Carlisle.—Beauties of England and Wales,
vol. ii. Cumberland, by J. Britton and E. W. Brayley,
1802. Lysons's Magna Britannia, vol. iv. 410. Cumberland,
1816.

WORKS, Opera, in Fortification, the several lines,
trenches, ditches, &c. made round a place, an army, or the
like, to fortify and defend it. See Line, Parallel, and
Trench.

The principal works in a fortress, or fortified place, see
under Fortified Place, Fortification, &c.

WORKS, Covenant of, in Theology. See Covenant.

WORKSBORN, in Geography, a river of Northumberland,
which runs into the North Tine.

WORKSOP, a market-town in the hundred of Basset-
law, and county of Nottingham, England, is situated 22
miles N. from Nottingham, the same distance N.W. from
Newark, and 146 N. by W. from London. The town is
small, but neat and pleasantly seated in a valley, near the
source of the river Ryton. According to the population
returns of 1811, the houses were then 759; and the inhabi-
tants 3702. A market, noted for malt, is held on Wed-
nesday, and fairs on the 20th of March, 20th of May, 21st
of June, and 3rd of October. Workhop, anciently Wirkensop,
was, before the Norman Conquest, the property of a Saxon
nobleman. Long afterwards it belonged successively to
the families of Furnival, Nevill, and Talbot, earls of
Shrewsbury. The Talbot estates descending to co-heiresses,
a part was conveyed to the Howards, earls of Arundel,
afterwards dukes of Norfolk, by whom the lands of Work-
shop are still possessed, and who, on this account, enjoy
the privileges of furnishing a glove to the king's right-hand
at his coronation, and of supporting that hand while he holds
the sceptre. Workhop was in former times defended by a
castle, long ago destroyed: but its site is still pointed out
on a circular hill, encompassed with a trench, at the W. side
of the town.

Workhop was formerly noted for its monastery, founded
by William de Lovetot, in the reign of Henry I., for canons
regular of the order of St. Augustine. The institution was
subsequently enriched by the gifts of various proprietors of
the town; but at the general dissolution its possessions
were seized by Henry VIII. Few vestiges of the monas-
tery now remain; but the church still partly subsists, and
is a noble specimen of ancient architecture. What now
remains is but the W. end of the original church, with two
lofty towers. The W. entrance consists of arches with
zigzag ornamentation, whilst the towers have the windows in
a gradation of different styles of architecture. The interior
of the church, in length about 135 feet, consists of a nave
and two aisles; the roof is supported by eight pillars, alter-
nately octagonal and cylindrical; the ancient pulpit is still
prevalent. On the N. side of the church are fragments of
walls; and foundations are discovered in the adjoining
meadows; but the most curious vestige of the ancient
buildings is a ruinous chapel, at the S.E. corner of the
church, now used as a place of burial, of which the windows,
still well preferred, furnish examples of the lancet form.
The gate of the monastery is nearly entire, and retains a
few of the statues with which it was formerly furnished.
The church and church-yard contain some monuments for
eminent personages of former times: one is the tomb of John,
brother of Ralph Nevill, the first earl of Wiltmoreland,
and treasurer of England. The trade of Workshop, and
its appendage Radford, has been much promoted by the
Chelmsfield canal, which passes close by the N. end of
the town. The vale of liquorice, formerly considerable, has
been for some years at an end, none being now raised in the
neighbourhood. On the S.W. of the town stands the
noble manion of the duke of Norfolk, styled Workshop-
manor, in the midst of a park, eight miles in circuit, con-
taining a great variety of ground, and much ancient timber
of a fine growth, having once been a part of the great
forest of Sherwood. The original manion was erected by
the renowned Talbot, the first earl of Shrewsbury, on a
scale of extent and magnificence suited to his character and
fortune; but in 1761 the whole was unfortunately burnt
down; by which accident, the loss sustained was very
great, not only in the furniture, but in the library, the
paintings, and the antique statues, part of the celebrated
Arundelian collection. Soon after this misfortune, the
duke of Norfolk commenced a new manion, on a plan
of great magnificence, comprising a quadrangle including
two courts; but the execution of the scheme was inter-
rupted by the unexpected death of the heir of the family.
One side, however, which is the front, has been finished,
and is 318 feet in length, of great elegance and grandeur.
In the centre is a portico of six Corinthian columns, on a
rustic basement. In the tympanum of the pediment is an
emblematic representation of the high alliances of the house
of Norfolk; and on the points are placed three statues.
The body of the building is crowned with an open balu-
trade. The interior contains many valuable paintings and
portraits of ancestors and connections of the family. The
chapel is adapted to the Roman Catholic service, to which
the dukes of Norfolk have always, with the exception of
the late duke, been steadfastly attached: it serves as a place
of worship for a number of parsons of the same perusing
residing in the neighbourhood.

At no great distance to the S. of Workshop-manor is
Welbeck abbey, the seat of the duke of Portland. This
place belonged to Swyn the Dane before the Conquest.
A monastery is supposed to have been founded in the reign
of Stephen, by Thomas de Cuckeney, for Premonstratensian
canons, who were removed from Newhouse in Leicestershire.
In the reign of Edward III., the manor of Cuckeney
was purchased by the bishop of Ely, and bestowed on the
monastery. At the dissolution it was purchased by a person
named Whalley, from whom it came to Sir Charles Caven-
dish, youngest son of Sir William, who married the cele-
brated co-heiresses of Shrewsbury. The son of Sir Charles,
afterwards duke of Newcastle, was the author of a well-
known treatise on horsemanship. His grand-daughter,
marrying John Hollis, duke of Newcastle, left an only
daughter and child, who by marriage was conveyed the
estates to the earl of Oxford; and their only child and
daughter by marriage transferred Welbeck to the an-
cestor of the present proprietor. The manion is a large
irregular structure, erected at different periods, contain-
ing, particularly within, portions of the ancient monastic
buildings. The greater part of what is now seen was con-
structed about 1564. The interior contains many spacious
and elegant apartments, which are decorated with a num-
ber of portraits of personages important in English history.
The grand riding-house and stables were erected by the noted duke in 1623 and 1625: having been long neglected they have been of late years restored, and are now among the most remarkable in the kingdom. Welbeck-park is about eight miles in circuit, and contains noble woods of venerable oaks, some of very great age and extraordinary size. One in particular, noticed in Evelyn’s Silwa, was in his time thirty-three feet round at the bottom, and is conceived to be 700 years old: it is now much decayed. But the most remarkable tree is the “duke’s walking-stick,” in height about 112 feet; the solid contents are estimated at 440 feet. Near the gate leading to Worktop is a group of trees, called the “seven sitters;” there having been formerly seven stumps springing from one root, but one has lately been broken off. The late duke formed an extensive piece of water in the park, and raised a bridge of three spacious arches over it, but which fell down just as it was completed.

About two miles to the eastward of the parks of Worktop and Welbeck is that of Clumber, a seat of the duke of Newcastle. The mansion is a magnificent stone structure of three fronts, one of which is ornamented with a light Ionic colonnade. The apartments are spacious, particularly the state dining-room, fifty feet in length, thirty-four in breadth, and thirty in height, which is fitted up with great magnificence. In the various rooms are several very valuable paintings. The arrangements for the domestic accommodation of the family are very worth of notice. The park, now eleven miles in compass, was not long ago a wide tract of forest-land. It is in a manner wholly the creation of the late duke of Newcastle. It now contains about 4000 acres; but half a century ago the ground was little better than a black heath, intermixed by bogs and marshes, through which ran a small stream. The park comprehends, however, two woods of ancient oaks, from one of which the mansion takes its name.

Adjoining to Clumber-park, on the south, is that of Thoresby, the seat of earl Manvers. The old house was destroyed by fire in 1745, after which it was rebuilt by the proprietor, the late duke of Kingston, grandfather of the present possessor. The mansion, which is rather a comfortable residence than a magnificent seat, consists of brick, on a rustic stone basement, with an Ionic portico of four columns in the principal front. The great hall, with fingle at the bottom, but divided into two at the first landing, opens into a dome supported by columns, on which rests a gallery, which communicates with the upper chambers. The apartments contain some valuable portraits and paintings. The park is about thirteen miles in circumference, and contains several pieces of water, of which one, near the house, assumes the appearance of an extensive river.—Thoroton’s History of Nottinghamshire, by Tho. in 3 vols. 4to. London, 1790. Beauties of England and Wales, Nottinghamshire, by F. C. Laird, 8vo. London, 1812.

WORLD, MUNDUS, the assemblage of parts which compose the universe.

The duration of the world is a subject which has been greatly disputed. Plato, after Ocelius Lucanus, held it to be eternal, and to have flowed from God, as rays flow from the sun. Ariotole was much of the same mind; he afferts, that the world was not generated, so as to begin to be a world, which before was none; and, in effect, his whole eighth book of Phys. and first book de Cælo, are spent in proving the eternity of the world.

He lays down a pre-existing and eternal matter, as a principle; and thence argues the world eternal. His argument amounts to this; that it is impossible an eternal agent, having an eternal passive subject, should continue long without action.

His opinion was long generally followed; as seeming to be the fittest to end the dispute among so many sects about the first cause.

Epicurus, however, though he makes matter eternal, yet shews the world to be but a new thing, and says it was formed out of a fortuitous concourse of atoms. See Lucretius, lib. v.

Some of the modern philosophers refute the imaginary eternity of the world, by this argument: that, if it be ab aterno, there must have been a generation of individuals, in a continual succession from all eternity; since no cause can be assigned why they should not be generated, vis. one from another. Therefore, to consider the origin of things, and the series of causes, we must go back in infinitum, i.e. there must have been an infinite number of men, and other individuals, already generated; which subverts the very notion of number. And if the cause which now generates have been produced by an infinite series of causes, how shall an infinite series be finite, to give room for new generations? See GOD.

Dr. Halley conjectures a new method of finding the age of the world, from the degree of saltmarshes of the ocean; which fee.

It is another popular topic of controversy, whether the world be finite, or infinite? See the arguments on both sides, under Universe.

It is likewise disputed, whether the plurality of worlds be possible? See Plurality.

Some hold the affirmative, from an opinion of the infinite power of the Deity; it being a setting bounds to omnipotence to say, that he created so many bodies at first, and that he could not create more.

The Cartesians maintain the negative, upon these principles: that it is a contradiction to say, there are several worlds existing at the same time, since this implies several univerces of created beings, the world being the sum of them. That if there were several worlds, they must either be at a distance from one another, or contiguous; but neither can be said; for were they contiguous, they would only constitute one, and were they distant, there must be something between. But what can be between? If it be extended, it is corporeal; and, instead of separating the several worlds, it will connect them all into one.

The existence of an external world has been much controverted. The arguments on either side, see under Abstraction, Body, and Existence.

The world is sometimes divided into upper and lower: the lower, or sublunary, is the globe of our earth (which see); and the upper includes the heavens, and heavenly bodies.

WORLD, Axis of the. See Axis.
WORLD, Map of the. See Map.
WORLD, Soul of the. See Anim. Mundi.
WORLD, System of the. See System.
WORLITZ, in Geography, a town of Saxony, in the principality of Anhalt; 5 miles E. of Delfau.
WORM, a river of Norway, which flows from the lake Mios into the Glom, or Glomen.
WORMDIT. See Warmstadt.
WORMHOUT, a town of France, in the department of the North; 5 miles S. of Borgues.
WORMIA, in Botany, a genus of plants first established by Rottboll, was named by him in memory of the famous Danith phyfician and naturalift, Olus Wormius, succeffor of

Gen. Ch. Cal. Perianth inferior, of five roundish, concave, very obtuse, coriaceous, permanent leaves. Cor. Petals five, roundish, concave, larger than the calyx, tapering to the base, deciduous. Stam. Filaments very numerous, crowded, short, equal; anthers terminal, linear, longer than the filaments, shorter than the petals, recurved, furled, by a double orifice at the summit. Styl. Gynem five, or more, superior, distinct, ovate, compressed, crowded; styles terminal, tapering, recurved, longer than the gynem; stigmas notched. Peric. Capsules as many as the gynem, and of the same form, each of one cell and one valve, furled at the inner edge, crowned with one of the permanent stigmas. Seeds several, from 8 to 12, roundish, "each with a pulpy tunic at the base." Salilib.

Ell. Ch. Calyx inferior, of five coriaceous, permanent leaves. Petals five. Anthers with two terminal pores. Capsules five, compressed, distinct, many-seeded. Styles thread-shaped. Stigmas notched. A genus of trees or shrubs, with rather twining stems, and round smooth branches. Leaves alternate, flat, ovate, coriaceous, with a single mid-rib, and many transverse parallel parallel ribs. Stipulae large, oblong, pointed, decumbent; the young ones convolute, forming a terminal point, as in the *Magnolia* tribe. Flower-flanks about the ends of the branches, opposite to the leaves, angular, either racemose or panicked; often unilateral. Flowers white or yellow. Calyx remaining coriaceous and dry, not becoming pulpy, in which, as well as the separate flagesma, and elongated styles, this genus differs abundantly from *Dillenia*. (See that article.) M. De Candolle notices the two terminal pores of the anther in *W. alata*, which he thought might afford a character for dividing the genus, if the same were not found in all the species. We find this character in *W. dentata*, as well as in our new *W. sericea*, and therefore venture to make it a part of the generic distinction.


2. *W. dentata*. Toothed Wormia. De Cand. n. 2. (Dilleniala dentata; Thumb. Tr. of Linn. Soc. v. 1. 201. t. 20. Willd. Sp. Pl. v. 2. 1253, excluding Rottboll's synonym. Poiret in Lam. Dict. v. 7. 151.)—Leaves ovate, abrupt, coarsely and rather sharply toothed. Foot-flanks simple, triangular, smooth. Flower-flanks triangular, from three to five-flowered. Gathered by Thunberg in Ceylon. We received a specimen, precisely answering to the above plate, in 1786, from professor David Van Royen, marked *Dillenia indica*; Reaumur of Koenig, by whom it was gathered; and Ghodaparra of the Cinghalese. This is a tree, with round branches. Leaves four inches long, of a broad, elliptic-ovate figure, very abrupt, coriaceous; paler beneath; entire at the base; wavy at the sides; molt toothed at the end; transverse ribs very straight. Convoluted fibula, at the end of the branch, acute, two-edged, smooth. Foot-flanks linear, narrow, near two inches long, acutely triangular, not bordered, smooth. Clusters simple, on a long, smooth, angular flalk, not quite opposite to the uppermost leaf, in our specimen conflituting of five flowers, whose partial flanks are about an inch long. Thunberg represents three flowers only, whose petals are obvate, about an inch in length.

3. *W. triquetera*. Triangular Wormia. "Rottb. Nov. Act. Hafn. v. 2. 532. t. 3." De Cand. n. 3.—Leaves ovate, bluntly, bluntly and slightly finnate. Foot-flanks simple, triangular. Flower-flanks triangular, racemose.—Native of Ceylon. Van Royen. Described by De Candolle from a dried specimen. "Branches round, brown, smooth, with an elevated ring round the origin of each leaf. Foot-flanks straight, two inches long. Leaves oval, or oblong; rather tapering at the base; obtuse, or somewhat pointed, at the end; either entire, or very bluntly and slightly waved; the ribs pinnate, (as in the left,) having about eight or ten lateral ribs at each side. Flower-flanks simple, nearly opposite to the leaves. Two outer calyx-leaves rather the largest. Petals concave. Stamens very short. Gynem triangular, crowded. Styles reflexed." Such is De Candolle's description, but he doubts whether this be a distinct species from the last. We have seen neither specimen nor figure, but the plant having been received from professor Van Royen, like our specimen of the preceding, rather confirms the doubt than removes it.

4. *W. alata*. Wing-flanked Wormia. De Cand. n. 4. (Dilleniala alata; Banks Ic. unpublished, communicated with specimens, in flower and fruit, to Linnaeus.)—Leaves oval, entire. Foot-flanks smooth, winged. —Gathered by Sir Joseph Banks, in New Holland, near Endeavour river. The branches are round, smooth, except the annular scars left by the fibulae. Leaves three or four inches long, and above half as broad, smooth, obtuse, with distant transverse ribs, and copious reticulated veins; their under surface rustily-coloured, but polished. Foot-flanks an inch or an inch and a half long, winged at each side with an entire leafy border, contracted at the apex, and quite smooth. Flower-flank opposite to the upper leaf of the branch, solitary, or rather racemose, triangular, smooth, shorter than the leaves, bearing two or three yellow flowers, larger than those of *W. dentata*. Petals undulated. Anthers long, linear, with two pores at the end, like *W. dentata*. Styles sometimes nine or ten, recurved. Capsules coriaceous, gaping, apparently real follicles, with a number of round seeds, inserted into the margins, deftite, as far as we can see, of any pulpy tunic.

5. *W. sericea*. Silky-flanked Wormia.—Leaves oval, bluntly finnate. Foot-flanks depressed, silken, as well as the flower-flanks and calyx.—Native of the East Indies. A specimen in the herbarium of the younger Linnaeus, which he supposed to be *Dillenia indica*, is marked "Mallii Mangafokera, a tree with snowy-white flowers." We cannot refer this to any thing in professor De Candolle's work. It undoubtedly belongs to the genus before us.

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WORMIA.
branches are round, strongly scarred; when young, finely downy. Leaves crowd about the extremity of each branch, apparently deciduous, being found on young shoots only, shaped like the leaf, and nearly as large; but somewhat ferrated, and, in a young state at least, finely downy; their transverse ribs much more copious, straight, and parallel, than in that. Footstalks half an inch long, stout, broad, and depressed, blunt-edged, not bordered, densely clothed with fine, white, silky, permanent down. Stalks simple, single-flowered, silky, about the length of the footstalks, each opposite to a leaf. Calyx-leaves obovate, concave, an inch long; smooth within; silky at the back. The petals we have not seen. Filaments short. Anthers long, compressed, two-edged, each opening by two terminal orifices. Germens crowded together. Styles five, recurved at the extremity. Stigmas small, abrupt.

We have at the end of the article Dillenia, hazarded an opinion, that the D. elliptica, integra, and retusa of Thunberg, as well as his dentata, above-described, belong to this genus of Wormia, to which professor De Candolle feems, by a remark under D. integra, in his Syll. v. 1. 437, disposed to agree. Probably he thought it best, having examined no specimens, to leave these plants where he found them, but we cannot omit the following, on the authority of Thunberg's figure.


WORMING, in Ship-Building, windling a rope close along the cutlines of larger ropes to strengthen them, and make a fair surface for the service. See Plate I. fig. 46. Rigging.

Worming, in Animals, an operation which is sometimes performed on the young of the dog and some other kinds. Young puppies are thus cut, in some cafes, under an igno-
rant lupposition that it prevents their going mad; but in reality to cure them, as it generally does, of the disposition to gnaw every thing in their way. It confits in the removal of a small worm-like ligament, situated beneath the tongue; and the part being afterwards loor for some days, the animal is thus weaned of his mischievous habits. See Diseases of Dogs.

WORMIUS, Olauus, in Biography, a Danish physician, descended from a family which fled from Arnhem, in Guelderland, to Denmark, from the persecution of the duke of Alva, was born at Aarhus, in Jutland, in 1588, and finished his education at the university of Marburg; afterwards availing himself of the lectures which he attended in the principal German academies, and in his tour through France, Italy, Switzerland, and Holland. He then returned to Denmark in 1610, and having in the following year taken the degree of doctor in medicine at Bafle, he passed through the Netherlands to England, and in 1613 returned to his native country, where by successive preferments he became professor of medicine in 1624, in consequence of the resignation of Caspar Bartholin. Although he obtained in 1636 a canonicate in the chapter of Lund, he continued his professional practice, and was often consulted by Christian IV. and Christian V. His knowledge of antiquities, medicine, and anatomy, was profound; and in 1628 he discovered bones in the human skull, called after his name “sex officiis Wormiana in futura crani lamioides.” His collection of curiosities was, after his death, lodged in the royal museum. He was three married, and had 18 children. He died in 1654. His writings were very numerous; and the principal of them are enumerated in the General Biography, to which we refer.

WORMS, in the Linnaean System of Nature. See VERMES.

Worms, in Husbandry, are very prejudicial to corn-fields, eating up the roots of the young corn, and destroying great quantities of the crop.

Sea-salt is the belt of all things for destroying them. Sea-water is proper to sprinkle on the land where it can be had; where the salt-springs are, their water does as well; and where neither are at hand, a little common or bay salt melted in water does as well.

Soot will destroy them in some lands, but it is not to be depended upon, for it does not always succeed. Some farmers threw on their land a mixture of chalk and lime; and others sprucely wholly to their winter-fallowing to do it; if this is done in a wet season, when they come up to the surface of the ground, and some nails with sharp heads be driven into the bottom of the plough.

If they are troublesome in gardens, the refuse brine of salted meat will serve the purpose, or some walnut leaves, flecked in a cirem of water for a fortnight or three weeks, will give it such a bitterness that it will be certain poison to them.

A decoction of wood-ashe, sprinkled on the ground, will answer the same purpose; and any particular plant may be fenced both from worms and snails by throwing a mixture of lime and ashes about its roots. It is a general caution among the farmers to sow their corn as shallow as they can, where the field is very subject to worms. Mortimer's Husbandry, p. 328.

In the roots of some sorts of garden crops, such as the carrot, onion, shallot, cauliflower, broccoli, and some others, worms and maggots are not unfrequently very injurious and hurtful, unless they be destroyed in sufficient time to prevent such effects. In the first, much advantage is supposed to have been gained by the full use of pigeon dung in preventing the worm.

And in this and the other sorts of garden crops it is found, that much benefit in removing such evils may be produced by a proper succussion of cropping, as that of following strawberries which have been four or five years planted with onions, and artichokes that have flooded the fame length of time with carrots; as these sorts of vermin do not attack either the strawberrie or the artichoke. In some cafes, it is supposed that it may be safe to crop two or three times with onions or carrots on the farm spot, but not oftener, as some appearances of the worm and maggot are generally displayed in the second or third year; but that from the ground being four or five years under strawberries or artichokes, plants on which those vermin cannot subsist, they soon perish, and the land where the rows flood has all the advantage of a new soil.

Soot when applied as a manure is said to be a good preventive of the maggot in onion crops; and that shallots, as requiring only a small spot, may be much improved in growth, and entirely preferred from the maggot, by the application of old hot-bed dung as manure, in the bottoms of the drills, well-mixed with foot; planting the shallots on this mixed manure, and covering them in to a proper depth. The foot in this cafe prevents the appearance of the maggot, and at the same time greatly improves the strength of
of the shallot plants: it is a method which has never been found to fail in preventing worms and maggots in such crops.

Cauliflowers, broccoli, and the roots of other fuch plants, may be preferred from the effects of worms, by watering the drills of them well with soap-fuds before planting them out, and afterwards occasionally: this not only, it is said, prevents the worm, but encourages the growth of the plants, and in some measure prepares the ground for other vegetables that are liable to the same sort of attacks.

The maggot is confidered by some as peculiar to the onion and shallot, and that whenever the former becomes diseased, it is most liable to its attacks; and that as it could never be detected in the soil, it is highly probable that the ovre or eggs of it are deposited in the root, and may be bached in the greatest numbers when the plants are in a fickly state. It is nicht oppofed, that the maggot ever paffes from one onion to another; but that any remedy which is sufficiently powerful to destroy the insect must inevitably destroy the onion itself; that all that can be done is, therefore, to feele proper foils and situations for the onion crops.

It is remarked, however, that the maggot which attacks the carrot is unqueffionably to be found in the soil, and that it visibly enters from without.

It is concluded on the whole, that worms and infects of these kinds in general are driven from their retreats under ground, by pouring bitter or acrid water upon it, as fuch in which green walnuts have been steeped, or of which a ley has been made by diflolving potafh. See several papers in the firft volume of the "Memoirs of the Caledonian Horticultural Society."

WORMS, in Medicine. Three species of worms infet the human body: namely, the ASCARIS, LUMBRICUS, and the TANIA or TAPE-WORM; which see repectively.

Worms were formerly oppofed to be a common caufe of a series of morbid symptoms, espeffially in children; but it is now well understood, that the difeafe affcribed to their influence is a marasimus depending upon other morbid conditions of the alimentary canal. The symptoms of this difeafe have been already detailed, under the head of Diff- eases of Infants, to which we refer.

Tin is often recommended as a good remedy again wormes, particularly of the flat kind. Dr. Aflton, in the Med. EFF. Edinb. vol. v. art. 7. directs an ounce and a half of the powder of pewter-metal to be mixed in half a Scotch mufhchin, or about half a pint English meafure of treacle, for children; but to growm perfous, he gives two ounces of the powder of pure tin, paffed through the finest hair-fieve, and mixed with eight ounces of treacle. As to the administration of this medicine, the original receipt directs half of it to be taken the Friday before the change of the moon; the day after, half the remainder, and the reft on Sunday. On the Monday, a purge is to be taken. The doctor thinks there is probably nothing in the particulars of the day; but says, the medicine succeeds well in feveral species of worms.

The efficacy of fern-root again wormes was known in the time of Dioscorides; and towards the beginning of this century, Mellefiers Andry and Marchant published accounts of fucceffful modes of exhibiting it in fuch cases. But it has been principally celebrated of late as a specific in the cure of the tania, or tape-worm.

Dr. Priefley, confidering how fatal nitrous air is to infects, and likewife its great antifeptic power, conceived that confiderable use might be made of it in medicine, in the form of clysters; and he apprehends, that if nitrous air was diluted with common air, or fixed air, the bowels might bear it better, and that it might still be destractive to worms of all kinds, and be of use to check or correct putrefaction in the interfinal canal, or other parts of the fystem. Priefley’s Obf. on Air, vol. i. p. 227.

WORMS, in Animals, a troublesome fort of vermin often found in the intestines of the horse, and fome other animals, caufing difeafee. See BOTTS, EARTH-WORMS, ASCARIDES, TANIA, and TERETES.

With refpe& to the caufe of worms in horfes, it is imagined, that, as in the human fubje&; fome constitutions are more inclinable to breed wormes than others. Gibfon fays, the moft ufual caufe of wormes is foul or high feeding, which occasion crudities and flimy indigifled matter in the ftomach and bowels, (efpecially in horfes that have been pampered for fale,) forming a proper nidus for wormes. This indeed may be the cafe, but the primary caufe of wormes is that which occafions these crudities, to wit, a want of energy in the functions of the ftomach and bowels, as wormes are never found in animals perfectly healthy in these refpects.

According to Gibfon, the signs of wormes in horfes are various, according to their different kinds. The botts that many horfes are troubled with in the beginning of fummer are always found looking to the rectum, and are often thrust out with the dung, along with a yellowish-coloured matter, like melted sulphur. They are no way dangerous there, but they are apt to make a horfe reflife and uneasy, and rub his breech againft the pots. The feafon of their coming is ufually in the months of May and June, after which they are seldom to be feen, and rarely continue in any one horfe above a fortnight or three weeks. Thofe that take poffe& of the membraneous portion of the ftomach are extremely dangerous in caufing convolutions, and are seldom discovered by any previous signs before they bring a horfe into violent agonies. See BOTTS.

But the teretes or earth-wormes give little difturbance to a horfe, and would hardly be discovered, unlefs they were feen now and then to come away with the dung. Frequenty horfes void one or two, and no more; and fometimes they will void pretty large quantities of the young brood, not much larger than the afcarides, only of a red colour, and not white, as the latter generally are. They are most ufual in autumn, or the beginning of winter, though a horfe may now and then void one or two of them at other times of the year.

However, the afcarides, or small needle-like wormes, are very troublesome to horfes, breed at all times of the year, and often when one brood is destroyed another fucceeds. There are not at all dangerous, yet when a horfe is pelted in this fort of way, though he will go through his buinefs tolerably well, and sometimes feed heartily, yet he always looks lean and jaded; his hair flares as if he was fickly, and nothing that he eats makes him thrive. That he feels pain, too, is plain, for he often flrikes his hind foot againft his belly, which fiews where his grievance lies, and is fometimes gripped, but yet without the very violent symptoms that attend a colic or strangury. He never rolls or tumfles, but only fiews uneafinesfs, and generally lays himself down quietly on his belly for a little while, and then gets up, and begins to feed; but the fureft sign is, when a horfe voids these wormes with his dung.

In regard to the cure, if a horfe be troubled with botte, Gibfon fays, he may be relieved without much expence or trouble, only by giving him a spoonful of favin, cut very small, once or twice every day, in oats or bran moiftened; and if three or four cloves of chopped garlic be mixed with
WORMS.

with the favin, it will do better, for garlic is of great
service in these complaints. Horses that are troubled with
botts ought to be purged with calomel and aloe purges
before the weather grows too hot; and if they be kept to a
clean diet after this, it will be a great chance if ever they
are troubled with them any more. As the botts generally
happen about the grafts seafon, these horses that are turned
out to grafts often get rid of them there, by the first
fortnight's purging; and, therefore, those that have the
convenience of a good pasture for their horses need not be
very licentious about giving them medicines.

And the earth-worms, which some writers call teretes,
routundi, or lumbrici, are also oftentimes conquered by calomel and
occasional aloe purges, for worms often come away in
purging, when, till then, it has not been known that the
horse was troubled with them; and it has been observed,
after these have been voided, that the animal has thiven
better, grown more lively, and shewn more alertness at his
business. There can scarcely be a better plan of treatment
than is supplied in the following formule, recommended by
Mr. Denny in his useful work:—Take of calomel, one
drachm; anifeeds, in powder, half an ounce; treacle, enough
to make a ball. This is directed to be given in the even-
ing; and the next morning the following:—Take of suc-
cotrine aloes, in powder, one ounce; ginger, in powder,
two drachms; treacle, enough, to make a ball; and
the above bolus and purgative ball must be repeated, with an
interval of nine days, until the horse has taken three dozes.

Then it is advised to give the following alternative powder,
daily for about a month; this process does not require
any change of diet, or involve any hazard from the effects
of cold:—Take of Ethiopia's mineral, crude antimony, pre-
pared, and aniseed in powder, each half an ounce; mix
them. The management of the horse during this course of
worm medicines is that in common cafes of phytic; but
some prefer giving Barbados aloes for the removal of
worms, thinking it the more efficacious, because its operation
is very rough; and Gibbon thinks it may be given to
hacksneys, and other horses of small value; but he never
found it more efficacious than the succotrine, at the same
time that it expoes a horse more to gripes and other dan-
gerous disorders, unless it be properly managed. The
following he gives as a cheap well-corrected purge of this
cord:—Take of Barbados aloes, one ounce; salt of tartar,
two drachms; ginger, grated, a drachm and a half; oil of
amber, a middling spoonful; syrup of buckthorn, sufficient
to make a ball. The only objection to this is the quantity
of aloes, which would be too considerable even if of a milder
fort for some horses.

It may be observed, that the fort of worms called aca-
rides sometimes come away from a horse in great numbers,
with the help of a purge, and some get quite clear of them
with purges only; but this does not very often happen,
for the horses that breed acaerides, above all others, are
subject to flime and founlefs in their intestines. In the
human body, acaerides are thought to be bred in the rectum,
near to the fundament; but in horses no other kind than
botts usually adhere to that gut. On the contrary, these
worms in them seem to be lodged about the beginning of
the small intestines near the stomach, where they feed on
the alimentary parts of the chyle. The botts in a horse
are often seen flicking near the sphincter ani, and are con-
tinually dropping away with the dung; but the acaerides
are seldom seen there, except when the animal has had a
purge given him, or when he falls into a natural purging,
which often happens from the irritation of the bowels, and
then they come away in very great numbers, accompanied
with much flime and mucus. Botts seldom alter a horse's
looks, but these not only make a horse grow lean, and look
emaciated, but on opening his mouth one may perceive a
more than ordinary languid whiteness, and a sickly smell,
instead of that liveliness of colour that is always perceivable
in the mouth of a sound and vigorous horse; so that, what-
ever be the primary cause, these worms seem in a great mea-
ture to proceed from a vitiated appetite and a weak
digestion, which renders them the more difficult to be re-
move: for which purpose recourse must be first had to
the foregoing remedies, and after them, such medicines as
are proper to strengthen the stomach, promote digestion,
and give tone to the solids.

The treatment advised by Gibbon for these worms
is chiefly the following:—Take of calomel, prepared.
two drachms; diapente, half an ounce; make these into
a ball, with a sufficient quantity of conservate of rotes,
and give it in the morning, keeping the horfe from
meat an hour or two before and after the dose; and
the next morning administer a moderate aloe purge,
taking great care to keep the horse from wet, or from any
thing that may expoe him to take cold. The above
calomel ball and the purge must be repeated in fix or eight
days, and again in fix or eight days more. Or the follow-
ing mercurial purge may be given, which will be les
troubleome, though not les efficacious:—Take of crude
quicksilver, two drachms; Venice turpentine, half an
ounce. Rub the quicksilver with the turpentine in a
mortar till no particle of the former appear; then add, oil
of favin, thirty or forty drops; succotrine aloes, in powder,
half an ounce; ginger, grated, one drachm; syrup of buck-
thorn, enough, to make it up into a ball.

One of these mercurial purges may be given in the fore-
going manner, viz. one in six or eight days, with all the
same precautions: it will work mildly, and with little or
no griping or sickness. And another mercurial purge,
which is proper to destroy worms and to cleanse the first
passages, is this:—Take of diaphragnum, calx of antimony,
and calomel, of each two drachms; succotrine aloes, fix
drachms; ginger, grated, one drachm; oil of favin, cloves,
or anifeeds, thirty or forty drops; syrup of buckthorn,
enough, to form the ball. To be given as the preceding.

When a horse has gone through a course of these mer-
curial purges, some advise the following drink to be given
two or three times a-week, or till the horse begins to thrive
and look healthy:—Take of rue, camomile flowers, flow-
hound, of each a handful; galangales, bruised in a mortar,
three drachms; liquorice-root, sliced, an ounce. Boil
these in a quart or three pints of forge-water fifteen or
sixteen minutes in a covered vessel, and keep it covered
till cold; then strain it through a piece of coarse canvas, and
give it in the morning upon an empty stomach.

Powdered tin has likewise been advising with the intention
of destroying worms; and also most of the preparations of
antimony: Sulphur is also good in all fuch cales; and even
crude antimony in fine powder, given with equal parts
of sulphur, often succeeds in the proportion of an ounce in
the morning and another at night.

The worms which infest the bodies of other animals of
different domestic kinds may be destroyed, expelled, or got
rid of, by the same remedies and modes of treatment, only
proportioning their quantities to the nature and strength of
the animals to which they may be given, and regulating the
manner of exhibiting and continuing them, to that of
the fates in which they may be at the time, from the effects
of the worms and other caules.

There is also a kind of worms which are frequently fatal
WORMS.

To the gallinaceous birds, of which a curious account has been given by Mr. Weinsenthal, in the Medical and Physical Journal. The inconvenience produced by these creatures is at first but slight: however, it gradually becomes more and more offensive, until it ultimately destroys the birds. Very few indeed recover; they languish, grow dispirited, droop, and die. It is found, on dissection, that these symptoms are occasioned by worms in the trachea. The writer has seen the whole of it completely filled with these worms, and has been astonished at the animal's being capable of respiration at all under such circumstances.

They are of a reddish colour, and at first view resemble the human lumbricus; but when examined are materially different. When exposed to the microscope, they are found to have an orifice or mouth at one end, formed for suction; the other end, as far as it can be ascertained, is imperforated. The intestinal tube is much convoluted, like that of the lumbricus.

It does not appear that any effectual remedy has been yet discovered for removing these most destructive animals. They have been drawn out of the trachea by means of a feather, stripped from near its end, which is patted into the larynx and twisted round, till it engages one or two of the worms, which are extracted, but without any relief to the animal, after the operation has been performed.

Worm, in Timber, a disease in growing fir, and perhaps other timber-trees, produced by a worm. For which it is supposed by Mr. Nicol, in his "Practical Planter," that there can be no remedy except in the draining and improvement of the soil. Indeed, this disease is not known on soils congenial to the nature of the plant; nor does it ever appear until the tree becomes sickly, by its roots having touched a cankered bottom.

It has been supposed this worm is the same with that which is found in deal, and some other sorts of wood.

Worms, Aquatic. See Water-Worms infra.

Worm, Ascaris, in the Linnean System, a genus of the order of intesina, and class of vermes; the characters of which are, that the body is round and filiform, and attenuated towards both ends. There are two species. See ASCARIDES.

Worm, Bee. See Generation of Bees.

Worm, Butterfly. See Aurella, and CATERPILLAR.

Worm, Canker. See SCARABEUS.

Worm, Cleft. See Gryllus.

Worm, Coelomic. See Coeus.

Worm, Connaught, or Connaught, in Natural History, a name given by the common people of Ireland to a kind of caterpillar found in many parts of that kingdom; and, from its ugly aspect, reputed to be poisonous.

It is said to be the only poisonous creature of that kingdom, and many mischievous effects are attributed to its sting, and to its poisonous quality, when eaten by cattle. As to the first of these opinions, it is evidently erroneous; the creature having no power to sting at all. The other is not so easily proved false, but is much to be believed. The reasons on which it is founded are these: the cattle in Ireland are subject to a very terrible disease, which is most frequent in autumn; about the time when these animals are in the greatest plenty.

It is most frequent also among those cattle which feed in low and marshy grounds, where this creature lives and feeds; cows and hogs, which feed in these places, are the only creatures subject to the distemper, and this is imputed to the cow's eating by large mouthfuls, because the chews the cud a second time; and the hogs feeding so foul and greedily, as to cut things which other creatures refuse. Finally, the great cause of afflicting this disease to this creature, is that the worm only appears in great numbers about once in seven years; and in these, and these years only it is, that the distemper among the cattle is common.

The symptoms by which this disease is distinguished from all others are, great swelling of the head, and a falling down of the anus; the gut often hanging out to the length of six or seven inches. The common cure among the more intelligent people is a strong decoction of the plant called bear's-foot, or great black hellebore, with some rue and garlic given with butter and beer; this is found to have great success with the cows. The hogs are cured only by mixing redlead, or the common red ochre powdered, with butter-milk, and making them eat a large quantity of it.

The Irish peasants have recourse to many idle remedies. The caterpillar, supposed to occasion this disease, feeds on the common ragwort, and is larger than most other creatures of this kind, being of the length and thickness of a man's finger; it is marked with two large spots behind the head, which are supposed by the vulgar to be the eyes, but are only round variegations, of the nature of those common on other caterpillars, and what they take to be a fling in the tail, is no other than a horn in that part, which is not peculiar to this caterpillar, but found on many others. That the common people are deceived in regard to the external parts of this creature is evident; but experiments are required yet to prove whether or not they are so, in regard to its poisonous quality.

One trial is remarked by Mr. Molynexus to have been made on a dog, who eating the skin of only one of the creatures was found dead about three days after; another dog, which drank the juices expressed from that skin, received no hurt. The insect is described in Lillie's edition, under the name of the elephant caterpillar. Phil. Trans. N. 168. p. 880.

Worm, Earth, lumbricus, a genus of the order of intesina, including two species. See Earth-Worm and LUMBRICUS.

Worm, Flower-root. See FLOWER.

Worm, Fly, in Natural History, the worm or maggot produced of the egg of a fly, and afterwards to be transformed into one.

These worms are to the fly, what the caterpillar is to the butterfly it produces. The custom of the world has appropriated the term caterpillar to that one species of the flying insects' first state; but we have unfortunately no term of distinction yet established for any of the first state of any of the other flying insects, the creature produced by the egg of the fly scarce being indeterminate called worm. Till more expressive names shall be invented for these, it may not be improper to distinguish those of the different classes by the additional name of the insect they are to be changed into; and to call that which is to become a beetle, the scarab-worm; that which is to be hereafter a fly, the fly-worm; and so of the rest.

Those which are to be hereafter winged creatures of the fly-clas are extremely different one from another in form and figure, and may very properly be arranged into several classes.

The most remarkable and striking differences between the classes of those creatures, are those of the form and shape of their heads. Many of them have heads which it is not easy to distinguish to be such, as they carry no one mark of the head of an animal visibly about them. There are many whose heads are variable at the pleasure of the creature, and which at times are seen to be more or less long, more or less thick, more or less flat, more or less shortened at pleasure.
by the animal, and early bent and turned about in any direction. The heads of these creatures are composed of a very soft and flexible flesh.

There are others whose heads are hard, and which always retain the same regular figure. The first general arrangement of these worms may be into those which have a variable, and those which have an invariable head. The subordinate distinctions may be deduced from the number, disposition, structure, and form of the other parts. Some worms of this kind have no legs; those of others are membranous or scaly; and others have them both membranous and scaly. Some worms have the power of altering the figures of their bodies at pleasure, both as to length and bulk: the bodies of others are rigid, and incapable of these changes. Some, again, have a thin membranous coat; whereas that of others is firm and scaly, or crustaceous. Moreover, considerable differences are observable with regard to the position, number, and figure, of their organs of respiration.

Among the fly-worms of variable heads, the disposition of the filgymata, or air-holes, at which the trachee of these animals terminate, will afford several distinctions of genera: e. g. the worms of the common flesh-fly has in its filgymata fix apertures, three in each, resembling button-holes; but the worms of many other flies have only one small eminence in each: others have them cylindrical and hollow, and projecting like horns, of which some have two, and others three, differently situated and disposed. The number and figure of the hooks, which serve these creatures for teeth, may also serve for matter of distinction. The common worm of the flesh-fly has two hooks, with a dart between them; others have hooks without a dart; some have one hook, and others none. The figure of the body, and the differences of size and colour, may furnish farther distinctions with regard to the genera of the first class.

Thole of the second class, which have variable heads, and differ from the former in having legs like those of the caterpillar clafs, have often a sort of hooks fastened to them: they have also a long flexible tail, capable of being lengthened or contracted at pleasure, and resembling the tail of a rat; whence these are called rat-tailed worms. In thefe worms, the tail is the principal organ of respiration; its end being always open, and supplying the office of the filgymata of the other genera.

The fly-worms of the third class, which have invariable heads, and have nothing analogous to the organization of moveable jaws, being pointed heads, or such as seem truncated, and no scaly legs: these form a very numerous family both in the terrestrial and aquatic kingdom, and all of them furnish two-winged flies. Under this class Reaumur enumerates and describes eight genera. This ingenious writer mentions worms of another class, which usually produce four-winged flies, having heads of an invariable figure, and two teeth or moveable jaws near the aperture of the mouth, without scaly legs, and with the filgymata placed on the sides of their bodies. The flies produced from these are, the bees, wapins, ichneumons, gall-flies, &c. There is another class of the hexapod, or fix-legged worms, which are transformed into some species of the libelle; which have no mouth, but two openings at the top of their antennae, through which their aliment may pass. The formica leo, and the puceron eaters, belong to this class. There is another class, which have bodies like those of the caterpillar clafs, and fix legs, besides two other shorter legs or hooks near their hinder part, which serve for motion and for fixing themselves. The water-worms, which make for themselves cases of different materials, and are transformed into papi-

WORMS.

laneous flies, are of this class. There is also a class of worms, called false or gallard caterpillars. See Fauses Chenille. See the more particular description of these clafs, and their subordinate genera, in Reaumur's Hist. Inf. tom. iv. p. 161, &c.

Worm, Guard, the name of a species of tanis, or tape-worm; the body of which is of an oblong form, flat on the belly, and rounded on the back; its skin is soft, and its mouth large, horizontal, and emarginated, or dentèd in the middle. It resembles the common gourd in figure, and from thence has got this name of wormis cucurbitinus, or the gourd-worm. It is frequently found in the intelles of animals.

Worm, Golden. See Aphrodita.

Worm, Guinea, or Hair-Worm. See Chelita, Ambisphaera, and Dracunculi.

Worm, Gally, Glow, Great, Gooseberry, Hay, Horse, Lycomachia, Musfrum, Oyster, Pile, Sheep-nose, Silk, Solitary, and Truffle. See the respective articles.

Worms, Meal. There are two very different insects found in our meal or flour; the one is so small, that it is only to be seen by the microscope; all that the naked eye can discover of it, is, that something is alive in the place, from the whole substance of the flour being in motion. See Flour.

The other meal-worm is larger, and more frequently offers itself to our observation; it consists of eleven rings, and has three pair of legs. The mouth of this worm is made into a kind of forceps, and from this arise, on each side, a great number of small pinacula; these serve instead of teeth, and the animal feeds by means of them. They are found sometimes very soft and tender, sometimes hard and firm; at some feaons they are very brisk and lively, at others they have scarce any life in them.

The most remarkable thing in regard to these worms is, that they are always exactly the colour of the flour which they live among. Ray has observed, that the white flour breeds white ones; the coarser flour breeds larger and greyer ones; and that flour which has the bran among it, breeds brown ones of the same colour with that of itself. This is a provision of nature for the safety of the animal, since were it of a colour different from that of the flour, it must be easily discovered among it, and would be picked out and thrown away. The caterpillar tribe are thus preferred, by being of the colour of the leaves they feed on; their green usually fuiting itself exactly to that of the tree or plant. Delalande, Trait. Phy.

Worms of the Sea. The sea-worms are of the number of those animals which, with the oyster and several other shell-fish, furnish us an infallice of animals which remain all their lives fixed in the manner of plants to one spot, whence there is no probability of their moving themselves.

These worms are included in a sort of cafes or pipes, and may be divided into two classes, according to the nature of those cafes. In one species these only are made of grains of sand, fragments of shells, and the like, fastened together by a viscous humour; and in the other they are composed of a true fleshy matter.

These worms which have fleshy cafes are fixed sometimes to the sand at the bottom of the sea, sometimes to stones, or sea substances, and sometimes to the shells of other fishes; their shells are rounded, and, in some degree, conic, as they always gradually grow wider from their point or apex to the mouth; as to the rest, their shape is different in almost every individual, forming divers irregular curves, and often resembling the shapes into which a common earth-worm curls and twits itself in its various motions.

When
When we consider the effects of the glutinous juice oozing from the body of this animal, in forming together any loose substances it meets with, so as to form a cake for it, it may be easily supposed that the adhesion of the balanomarin, and other the like shells, which remain all their lives fixed to some one spot, is performed in the same manner. Mem. Acad. Par. 1711. See **Vermicularia**.

**Worms.** It is a singular fact that there are some of these which transform themselves by a singular process, without any visible change in its exterior form, into flies, and belong to the third class of fly-worms. They are particularly described by M. Reaumur, Hist. Inf. tom. iv. p. 510, &c.

There is a singular species of these creatures, which is found to be capable of reproduction or multiplication from cuttings, in the manner of the polypus.

The discovery Mr. Trembley made of this strange property in the polypus, gave occasion to the trying of the experiment in regard to some other insects. Worms were the most natural objects of these experiments; and though they failed in many species, they yet succeeded in some, and proved, that nature has not given that amazing property of reproduction of its most essential parts, to only one species of animals.

Mr. Bonet tried the experiment on a very nimble kind of water-worm, by cutting it into two in the middle, and the succedae perfectly answered the expectation; for the two pieces continued alive and vigorous, and in a little time became two complete worms. The structure of these worms, though it appear simple to the naked eye, is very worthy the examination of the microscope, and when viewed with this assistance, there are discovered in it parts extremely deserving our attention. Phil. Trans. N°469. p. 470.

Dr. Hales, in his Vegetable Statics, relates a curious experiment, by which it is proved that the bones of animals, when they are ossified to a certain degree, do not grow any longer, except at their extremities; and the cafe is the same in regard to these worms; for the old piece, which is the middle of the animal, never lengthens itself, but the addition of new rings to each end makes the increas of length in the worm.

In all these pieces the liquor, which serves as blood to the animal, is found circulating from the tail-part towards the head, in the usual way; and by this motion of the blood it is always easy to know, even in the smallest pieces, which is the head and which the tail-end, and the new head and tail are always seen to come regularly from the proper ends. Phil. Trans. N°469. p. 470, &c. See **Reproduction**.

**Worm,** in Chemistry, denotes a long, winding pewter-pipe, which distillers and apothecaries place in a tub of water, to cool and condense the vapour in the distillation of spirits.

This the chemists also call a **serpentine.** Formerly, this worm, or something like it, was placed above the head of the still, with a refrigirator at the upper end of it, which is useful enough in the distillation of spirit of wine.

**Worm,** in Gunnery, is a single or double-wired iron screw, mounted on a wooden handle by means of a socket, or fixed on the end of a rammer, to pull out the wad of a cannon, firelock, carabine, or pillion; it is the same with the **noodle-book,** only the one is more proper for small fire-arms, and the other for cannon.

This instrument serves to draw out the wadding, or pieces of cartridges, which remain in the gun after frequent firing, and which would otherwise accumulate so much, that other cartridges could not be rammed home enough to reach the priming, whereby the gun would misfire.

To **Worm a Cable or Hauler,** in Sea Language, signifies to strengthen it, by winding a small line, or rope, all along between the flarnds.

**Worm-Powders.** See **Powder.**

**Worm-Seed, Semen Contra, Semen Sanctorum, or Semen Santonicum,** is a hot, bitter, drying kind of seed, proper to destroy worms generated in a human body, and particularly in children.

This feed is light, small, oval, composed of a number of thin membraneous coats, of a yellowish-green or brownish colour, easily friable on being rubbed between the fingers into a fine chalky kind of substance, a bitter taste, and a strong smell. It must be chosen new, greenish, of a sharp, bitter, aromatic taste, not a little disagreeable.

The place where it is produced is Persia, about the frontiers of Muscovy. It is brought to us from Aleppo, &c. Naturalists have not been agreed about the plant that produces it.

J. Bauhine has a large dissertation on the subject. Some will have it the species of absinthium, or wormwood, called *fantonium,* or *marinum absinthium,* others will have it the *taneacutum,* others the *abrotonum,* but it is now supposed to be the produce of a species of *artemisia,* resembling in its general appearance our fine-leaved mugwort, called by Linnaeus *artemisia fantonica,* and the *artemisia auftriaca* of Jacquin.

M. Tournefort gives us the following account of this notable drug, in the second volume of his Travels. The fennentive, or worm-powder, is not gathered like our seeds. The plant grows in the meadows, and must be let ripen, and the mischief is, that as it grows near to maturity, the wind featters a good part of it among the grass, where it is lost; and this makes it so dear.

As they dare not touch it with the hand, for fear of making it spoil the sooner, when they would gather what is left in the ear, they have recourse to this expedient. They take two hand-baskets, and, walking along the meadows, sweep the baskets, the one from right to left, the other from left to right, as if they were mowing; by this means the feed is shaken out into the baskets.

These seeds have been chiefly recommended as anthelmintics, and commonly taken, in this intention, either along with molasses, or candied with sugar. For other purposes they appear to be a strong bitter. They give out their virtue both to water and spirit. The extract made by rectified spirits, appears to be the most eligible preparation of the fanthornium for the purposes of an anthelmintic; and the watery extract, or a tincture drawn from it, for the more general intentions of bitter medicines.

Some have ascribed their quality of destroying worms solely to their bitternes; but it appears from Baghini, that worms (lumbrici) immered in a strong infusion of these seeds were killed in five, and according to Redi seven or eight hours; while in the infusion of wormwood, and in that of agaric, the worms continued to live more than thirty hours; and hence it has been inferred, that their vermifuge effects would not wholly depend upon the bitternes of this feed. To adults, the dose in sublimate is from one to two drachms in a day. (Woodville's Med. Bot.) The worm-seeds of former pharmacopoeias are now properly rejected, as their place is supplied by anthelmintics of more certain efficacy.

**Worm-Tincture,** in Chemistry, a name given by many to a medicine prepared by Hoffmann from earth-worms; and in many parts of Germany esteemed one of the most noted medicines in the world, though less known in other places.

The
The preparation is this: the worms are to be collected in the spring or summer months, and the larger sort are the bell. They are to be carefully dried, and reduced to a fine powder; this powder is to be mixed up into the consistence of a poultice, with oil of tartar per deliquium, and this to stand twenty-four hours; then spirit of wine is to be poured on it, so as to reach three fingers-breadth above it, and a drachm of saffron, and half a drachm of caltor, are to be added, and the whole is to stand three days in infusion, and after this be filtered off for use. Some add a small quantity of opium to the tincture, but as it is often wanted in cafes where opium is not proper, it is better to keep it separate thus made; and when there is occasion to have it opiated, to add as many drops of laudanum as is judged necessary.

The oil of tartar in this cafe penetrates the very innermost structure of the worms, and is a means of extracting such a tincture from them, as no art could otherwise contrive to make; and the medicine becomes, according to Hoffmann, much more than an anodyne, from the admixture of the salt of tartar in the tincture.

When it is intended to be made with opium, it is always proper to add also some of the hound's-tongue root, which is found as an anodyne to emulicate the virtues of opium.

This tincture, whichever way prepared, is excellent in abating the pains of diætes that do not admit a cure. The fits of the gout are rendered easier by every dose of it; and even in cancers, the pain is quieted in a wonderful manner by it, and life rendered much more supportable.


Worms, in Geography, late a bishopric of Germany, in the circle of the Upper Rhine, surrounded by the Lower Palatinate, the county of Katzenelnbogen, and the electorate of Mentz; about ten miles in length along the borders of the Rhine. In ancient times, the Vangiones inhabited this district. In the middle ages it was called "Wormsfeld," "Wormatsfeld," or "Wormfergauf," and one of the bishopric, named Victor, is said to have afflicted a council at Cologne, in the year 347. Of the ancient bishops here, however, we have little certainty. The series of the prelates of Worms, which may be most depended on, begins with Erembert, who was appointed bishop thereof about the year 770. The bishop of Worms was subject to the archbishopric of Mentz. In the circle of the Upper Rhine, he was the summoning prince and director. In the council of the princes of the empire, he exchanged place on the spiritual bench with the elector of Wurzburg. The whole of the bishopric situated on the left side of the Rhine is annexed to France, and included in the department of Mont Tonnerre.

Worms, a town of France, in the department of Mont Tonnerre, late an imperial city of Germany, in the circle of the Upper Rhine, and capital of a bishopric of the same name, anciently the capital of the Vangiones. It was situated nearly in the centre of the diocese to which it gave name, not far from the Rhine, and near the place where the Eibach and Giefenbach fall into it. This city was accounted one of the free Lutheran imperial cities, with toleration and freedom of worship to the Catholics. The Calvinists had also a church here. To the Catholics belonged not only the cathedral, but likewise four collegiate and the like number of parish churches in or near the city, a college, a gymnasium, three convents, and three nunneries. The bishop's palace here was built quite new, in 1719, at the expense of bishop Francis Louis. The kings of the Franks appointed counts and dukes over it. From time immemorial it has been termed a free imperial city, and is so styled in some records of the emperor Charles IV., bearing date in 1355 and 1356, and in the register of the cities of 1386, and was also acknowledged such in 1479, in the diet at Nuremberg; and by the emperor Maximilian I., in formal instruments of 1507 and 1508. In 1495, 1521, 1545, and 1576, diets were held here, and this was the place in which the reformations began in 1525. In 1743, a treaty was concluded here between his Britannic Majesty, the queen of Hungary, and the king of Sardinia. In the beginning of the revolution, Worms surrendered to the detachment of the French republican army, and was laid under a heavy contribution by Culline, but evacuated after the losses of Mentz. It was again taken in 1794; 25 miles S. of Mentz. N. lat. 49° 36'. E. long. 8° 22'.

Worms. See Dornm.

Worms’s Head, or Pennyn Gwyr, a rock on the south coast of Wales, in the county of Glamorgan. N. lat. 51° 36'. W. long. 4° 17'.

Wormsdorf, a town of Saxony, in the circle of Leipzig; 20 miles E. of Leipzig. N. lat. 51° 16'. E. long. 12° 35'.

Wormser Joch, a mountain of the Tyrolese, between the sources of the Adige and the Adda; 8 miles S. of Glurentz.

Wormville, a town of United America, in the Mississippi territory.

Wormwood, Absinthium, in Botany. See Artemisia Absinthium.

The common wormwood, artemisia absinthium of Linnaeus, grows wild about dunghills, and on dry waste grounds, flowers in June or July, and may be propagated by slips in March or October, or raised from seeds sown soon after they are ripe. The leaves have a strong offensive smell, and a very bitter nauseous taste; the flowers are equally bitter, but less nauseous; the roots are warm and aromatic, without the bitternesses and offensiveness of the other parts; the leaves loose part of their ill smell by being dried and kept for some time. The active parts of this plant feem to be extractive, effficient oil, and a small portion of resins. Wormwood leaves give out nearly the whole of their smell and taste both to aqueous and spirituous menstrua; the former, prepared without heat, being the leaf ungrateful. Rectified spirit elevates little from this plant in distillation; water brings over nearly the whole of its smell and flavour. Along with the aqueous fluid there arises an effficient oil, which smells strongly, and tastes nauseously of the wormwood, though not bitter. The oil drawn from the fresh herb is commonly of a dark green; from the dry, of a deep yellow-brown colour. The quantity of oil varies according to the feaon and soil in which the wormwood is produced: in some years, ten pounds have afforded upwards of two ounces; in others, twenty pounds have yielded little more than one ounce. Geoffroy observes (Mem. Acad. Par. 1721), that in rainy leasons and moist soils, it yields the most oil; that in dry years the oil is accompanied with a resinous matter, and proves of a fine green colour; and that in wet leasons it is less resinous, and not green. A decoction of wormwood in water, long boiled, and inpiilated to the consistence of an extract, loses the smell and flavour of the plant, but retains its bitternesses. An extract, made with rectified spirit, contains, along with the bitter, nearly the whole of the nauseous part; the watery extract gives out its simple bitternesses, not only to water again, but to rectified spirit.

Wormwood is a moderately warm flomachic and corromborant; for these intentions it was formerly in common ufe, but it has now given place to bitterns of a lefs ungrateful kind. An infusion of the leaves, with the addition of fixed alkaline
alkaline falt, is a powerful diuretic in drophical cafes. The essential oil is sometimes given, in doses of a drop or two, properly diluted by solution in spirit of wine, as a mild antispasmodic. Its more frequent use is a vermifuge: for which purpose it is both applied to the belly, and taken in pills made with crumb of bread. Dr. Lewis, however, says, that the spirituous extract promises to be, in this intention, preferable to the pure oil; as it contains, along with the oil, all the bitter matter of the wormwood. This plant very powerfully refits putrefaction, and is made a principal ingredient in antifeptic fomentations.Boerhave commendeth, in tertian agues, a medicated liquor, prepared by grinding about seven grains of the oil with a drachm of sugar, and two drachms of the alkaline salt extracted from the ashes of wormwood, and afterwards distilling the compound in fixed ounces of the distilled water of the plant. Two hours before the fit is expected, the patient is to bathe his feet and legs in warm water, and then drink half an ounce of the liquor every quarter of an hour, till the two hours are expired: by this means, he says, cafes of this kind are generally cured with ease and safety, provided there is no cirrhosis or dyspepsia.

Dr. Lewis observes, that this medicin is a very serviceable aperient, where obstructions of the vifera prohibit the immediate use of the bark, and in such obstructions as the imprudent use of the bark may have occasioned. Its virtues, he says, might be improved by an addition of the bitter water extract; though the compound, thus laboriously prepared, would not be at all superior to a simple infusion of the plant in pure water, impregnated with a due proportion of fixed alkaline falt.

The roots of wormwood, says Dr. Lewis, promise to be applicable to some useful purposes: their virtue refides chiefly in the cortical part: and rectified spirit extracts their flavour more perfectly than watery liquors. The Edinburgh college directs a tincture of the dried flowering tops of wormwood, in the proportion of six ounces to a quart of rectified spirit, under the title of /Inula absinthii./ This, in the opinion of Dr. Cullen, is a light and agreeable bitter, and at the same time a strong impregnation of the wormwood. Dr. Cullen concurs with Bergius and Gladitch in ascribing to the odour of wormwood a quality of occasioning some confusion of the head; and formerly, he says, when it was the fashion with some people in the country to drink purl, that is, ale in which wormwood is infused, it was commonly alleged to be more intoxicating than other ales. This effect he inclines to attribute to its narcotic power; and he is of opinion, that there is in every bitter, when largely employed, a power of destroying the sensibility and irritability of the nervous power. The dose in finance may be 3j to 9j, and of the infusion, made by macerating 3j of the plant in 5j of water, 3j to 8j times three or four times a day. Lewis’s Med. Med. Woodville’s Med. Bot.

The ashes of wormwood afford a more pure alkaline falt than most other vegetables, excepting bean-flats, broom, and the larger trees. In the Amoen. Acad. vol. ii. p. 160. Linnaeus mentions two cafes, in which an effence, prepared from this plant, and taken for a considerable time, prevented the formation of stones in the kidneys or bladder; the patients forbearing the use of wine and acids. Many nauseous effects are destroyed or driven away by the smell of this plant; and it is no uncommon practice among the good women in the country, to preserve their clothes from moths, by laying bundles of dried wormwood among them.

Some of our brewers have a method of using wormwood instead of the hops, to give the bitter taste to their malt-liquors, and to preferve them. It is found to answer the latter purpofe very well; but the taste is so disagreeable, that it is much complained of. The reason of this is, that the people who use it do not understand the time of gathering it.

All plants are full of juice while in the shoot, but fullest of virtue when they have their feeds on them. This is the cafe with wormwood, as well as a thousand others; and though, in the feeding-time, it produces much more flavour than when younger, yet it is without that nauseous bitter of the crude juice, which gives us the diftaste to the plant. Some people have found the proper way of managing wormwood, and have given a flavour with it to their malt-liquors, even preferable, in the opinion of all palates, to that given in the common way by hops.

The method is this: the plant is to be gathered when fully ripe, and the feeds upon it, and in this state hang up in small bunches to dry. When thoroughly dried, a certain quantity of good strong malt-liquor is to be impregnated with it, to the utmost strength that it can possibly give it. This is to be set by for use, to add to all the ref. When the hops should in the common way be added to the beer, this liquor is to be added in a proper quantity, making the tale the judge when there is enough of it. By this means just what degree of bitter is required may be given to the liquor, and the bitter of this common plant, thus managed, is as perfectly agreeable as that of any vegetable in the world.

The wormwood, for this purpose, should have its seeds carefully preferred in the drying, and it is best if not used till the year it was gathered. Phil. Trans. N° 124.

The essential falt of wormwood is afforded in great quantity, and poifeffes in many refpects the virtues of the plant. It does not differ from other vegetable fixed alkalies, provided they be equally pure.

Wormwood shares with all other bitters the virtues of an abortive deobtruent, and is in some degree purgative, as all Bitters are. Wormwood is one of those plants which the chemifs have generally chofen for their procelfes of the refufication of plants from their ashes; and though the pretended principles of this art are false, yet there have been some of the artifals fo cunning as to fform representations of this plant, that have deceived and puzzled the greatest unbelievers, though they have not convinced them. Phil. Trans. N° 74.

Wormwood, Sea, /Artemisia maritima/ of Linnaeus, falsely called in our markets /Rumon wormwood/, and substituted for it: it is a native of Brittan, and grows plentifully about our falt-marshes, and in feveral parts on the fea-coaft, flowering in Augluf and September. In tale and smell it is less unpleafant than the common wormwood; and hence is preferred by the college as an ingredient in some of the diffilled waters; the effential oil is less ungrateful, and the watery extract lets felfier than thefe of the common fort. The virtues are the fame, differing only in degree. It is lefs effectual as an afeeptic and antihemimtic, but more eligible as a fiafamique. A coversar of the tops, made by beating them with three their weight of fine fugar, is kept in the hops; but it is now scarcely ever ufed.

Wormwood, /Rumon, Artemisia pontica/ of Linnaeus, has more numerous, more finely divided, and darker coloured leaves than the former, and is hoary only underneath, whereas that is hoary all over. This is a foreign species, but as hardy and as easily raised as the others. It is con- siderably
Wormwood, ewer of Linnæus, is fine-leaved, and covered with a glossy, silk-like down. The mountain wormwood of Valais, or absinthium seriphium montanum candidum C. B. is covered with a cotton-like down, and the leaves are curled about the edges. Haller informs us, that the frill of these plants is frequent in flaky grounds on the Alps and the second by the sides of sandy roads in the territory of Valais, in Switzerland; that the former is bitterish and aromatic, of great effluence among the inhabitants of the Alps, and the common remedy against the intermittent fevers which often rage there, and for exciting the menstrual discharges, checked by the cold; and that the latter has an acid aromatic smell and taste, without bitterness, and prome, from its sensible qualities, to be a plant of great virtues. They have not yet been introduced into practice in this country. Lewis. See Artemisia.

**Wormwood-Tree,** in Gardening. See Artemisia.

**Wormwood-Ply,** in Natural History, a very small black fly, found on the italks of the common wormwood in June and July.

**Wormwood-Wine,** Vinum Absinthites. See Vinum, and Asinthites.

**Worofidow,** in Geography, a town of Poland, in the palatinate of Braclaw; 26 miles N.E. of Braclaw.

**Woronetz,** a town of Ruffia, in the government of Orlof, situated on a river of the same name, near the spot where it falls into the Don, and thus polluting an early intercourse with the Black Sea. It is qualified for becoming a great capital, being placed so as to enjoy the advantages of both warm and cold climates, and holding an intercourse with all parts of the empire. The streets are wide, but not paved. Tallow is a great article of trade here, and also iron. Here is also the most considerable cloth manufactory in Ruffia, first established by Peter the Great; the gypsy tribe is very prevalent here.

**Worpe,** a river of Germany, which runs into the Wumme, 7 miles N.E. of Brremen.

**Worral,** in Zoology, an animal of the lizard kind, of about four feet long, and eight inches broad, with a forked tongue, which it puts out like a serpent, but without teeth.

It is a harmless animal, and feeds only on large flies, and the smaller species of lizards. It is found in Egypt only during the hottest months, and principally frequents the grottos and caverns in the mountains on the west of the Nile, where it sleeps during the winter season.

It is said to be greatly affected by music, but experiment shews this to be an erroneous opinion. Pococke's Egypt, vol. i. p. 208.

**Worsborough,** in Geography, a village of England, in the county of York, with a medicinal spring; 3 miles S. of Barnesley.

**Worse,** a river of England, which runs into the Severn, near Bridgenorth.

**Worship of God,** Cultus Dei, amounts to the fame with what we otherwise call religion.

This worship consists in paying a due respect, veneration, and homage to the Deity, under a certain expectation of reward. And this internal respect, &c. is to be shewn and testified by external acts; as prayers, sacrifices, thanksgivings, &c.

The Quietists, and some other mystic divines, set aside not only all use of external worship, but even the consideration of rewards and punishments. Yet, even the heathens had a notion, that God did not require us to serve him for nought; "Dù quamobrem coëndi sunt," says Cicero, "non intellego, nullo nec accepto a illis nec sperato bono."

The school divines divide worship into divers kinds, viz. latraria, that rendered to God; and idrolatry, that rendered to idols, or images. To which the Romanists add, divusia, that rendered to saints; and hyperdulia, that to the Virgin.

Some theological writers have observed, that the Greek word εὐπροσκυνέω, to worship, is not descriptive only of the honour which is appropriated to God, but is indifferently used to signify the honour and respect which are paid to superiors of all kinds, in heaven or on earth. Accordingly, they have distinguished between civil and religious worship.

The general principles upon which the worship of God is considered as an exercise or act of religion, to which its meaning is commonly appropriated, have been already stated under the articles Prayer and Sunday; and it has been illustrated in the different views of it, as private, domestic, and public. To this article we have referred the more particular consideration of public worship, as a duty of indispensible obligation, and of indisputable importance and utility. If the worship of God, says archdeacon Paley, be a duty of religion, public worship is a necessary institution; because without it, the greater part of mankind would exercise no religious worship at all. Besides, assemblies appointed for this purpose afford regularly recurring opportunities for moral and religious instruction to those who would otherwise receive no such instruction. If we advert to fact, it will be found that the general diffusion of religious knowledge among all orders of Christians, in all Protestant, and in most Christian countries, compared with the intellectual condition of barbarous nations, can be ascribed to no other cause than the regular establishment of assemblies for divine worship; in which portions of Scripture are recited and explained, or the principles of Christian erudition are so constantly taught in sermons, incorporated with homilies, or expressed in extemore prayer, as to impress, by the very repetition, some knowledge and memory of these subjects upon the most unqualified and careless hearer. If this practice were not observed even by those members of the community who do not so much need the assistance that is indispensible with regard to others, and sanctioned by their profession and example, we may easily foresee how soon religious assemblies would sink into contempt and disuse. This argument meets the only serious apology that can be made for absence from public worship. But even this is a very insufficient apology in another point of view, because public worship is a duty, independently of the effect of example, of univerfal obligation. Man is a social being; and as such enjoys many blessings which demand public acknowledgment, and is chargeable with many errors and transgressions which he ought publicly to unite with others in confessing, and is exposed to many evils which he should deprecate in common with others who are in the same fallible or mutable state with himself.

"Surely, some will say," as Paley states another objection against public worship, "I may be excused from going to church so long as I pray at home, and have no reason to doubt but that my prayers are as acceptable and efficacious in
WORSHIP.

in my closet as in a cathedral; still less can I think myself obliged to fit out a tedious sermon, in order to hear what is known already, what is better learnt from books, or suggested by meditation.” They, whose qualifications and habits best supply to themselves all the effect of public ordinances, will be the last to prefer this excused, when they advert to the general consequence of setting up such an exemption, as well as when they consider the turn which is here to be given in the neighbourhood to their absence from public worship. You stay from church, to employ the sabbath time at home in exercises and studies suited to its proper business: your next neighbour flies from church, to spend the seventh day less religiously than he paid any of the fix, in a sleepy, stupid ret, or at some rendezvous of drunkenmen and debauchery, and yet thinks that he is only imitating you, because you both agree in not going to church. The same consideration should over-rule many small cerumens concerning the rigorous propriety of some things, which may be contained in the forms, or admitted into the administration of the public worship of our communion; for it seems impossible, that even “two or three should be gathered together” in any act of social worship, if each one require from the rest an implicit submission to his objections; and if no man will attend upon a religious service, which in any point contradicts his opinion of truth, or falls short of his ideas of perfection.

We may add, that there are other valuable advantages resulting from religious assemblies, that are not immediately designed in the institution, or contemplated by the individuals who compose them; e.g. 1. Joining in prayer and praises to their common Creator and governor has a beneficial tendency to unite mankind together, and to cherish and enlarge the generous affections. 2. Aims and emblems for the purpose of divine worship, placing men under impressions, by which they are taught to consider their relation to the Deity, and to contemplate those around them with a view to that relation, force upon their thoughts the natural equality of the human species, and thereby promote humility and condescension in the highest orders of the community, and inspire the lowly with a sense of their rights. Thus, things are made to appear little, by being placed beside what is great. In which manner, superiors, that occupy the whole field of the imagination, will vanish, or shrink to their proper dimensions, when compared with the distance by which even the highest of men are removed from the Supreme Being; and this comparison is naturally introduced by all acts of joint worship. If ever the poor man holds up his head, it is at church; if ever the rich man views him with respect, it is there; and both will be the better, and the public profited, the oftener they meet in a situation in which the consciousness of dignity in the one is tempered and mitigated, and the spirit of the other exalted and confirmed. Moreover, the public worship of Christians is a duty of divine appointment. (Matt. xviii. 20. Heb. x. 25.) Independently of these passages of Scripture, a disciple of Christianity will hardly think himself at liberty to dispute a practice set on foot by the inspired preachers of his religion, coeval with its institution, and retained by every sect into which it has been since divided. Paley’s Philos. vol. ii.

As to the manner in which public worship should be conducted, if we advert to the history of the primitive church, we shall find, that when the congregation was assembled, the first act of divine service which they performed was the reading of the Holy Scriptures. (See Tertullian de Anima, c. 3. Justin Martyr, Apolog. ii.) When the reading of the Scriptures was ended, then followed the singing of psalms. (See Tertullian, ubi supra. Pliny Epit. ad Trajan. Clemens Alex. Stromat. i. 6. Origen, De Orat. § 6.) The psalms or hymns which were sung by the primitive Christians were either taken out of the Holy Scriptures, and particularly out of the book of Psalms, or such as were of their own private composition. (Tertullian, Apolog. c. 39.) As to their manner of singing, it was, says Origen, (De Orat. § 6) in good tune and concert, all the people bearing a part in it. With respect to church-music, organs, and the like, were not known in the primitive ages to which we now refer; for it cannot be rationally conceived that in those days of continual persecution or violence they could either use or preserve them. The singing of psalms was followed by the preaching of the word. (See Tertullian de Anima, c. 3.) The subject of the sermon was usually a commentary or explanation of the lessons that had been just before read. (See Jufl. Martyr, Apolog. ii. Origen contra Celsum, lib. iii.) As for the length of the sermon, it usually lasted an hour. It began with an exordium, and then explained verse after verse, and sentence after sentence, shewing the natural and literal signification of the words, and then the spiritualized or mystical meaning of them, and concluded with a suitable application of all, either by way of exhortation to piety and virtue, or by way of dehortation from vice and impiety; always accommodating the discourse to the capacities of the hearers. (Origen contra Celsum, lib. iii.) The preacher was usually the bishop of the parish. (Jufl. Martyr, Apolog. ii.) Or, the bishop decreed a presbyter, or some other fit person, to preach in his room. When the sermon was finished, the congregation rose up to present their common and public prayers unto Almighty God (Jufl. Martyr, Apolog. ii.); standing being the usual posture of praying, at least the constanl one on Sundays, on which days they esteemed it a sin to kneel; and the preacher frequently concluded his sermon with an exhortation to his auditors to stand up and pray to God, which is found to be the case in Origen’s sermons. When the congregation stood up, all turned their faces towards the east, which was their usual custom (Tertullian, Apolog. c. 16.); for which practice they alleged the following reasons: 1. Respect and reverence to their lord and master Jesus Christ; this being the title given to him in the Old Testament, according to an erroneous translation of the word branch in the Septuagint. So that the east was called by Tertullian a type of Chrifl. 2. The similitude (Zach. vi. 12.) of the rising of the sun to our spiritual arising out of the darkness of sin and corruption, as Clem. Alex. expresses it. (Stromat. lib. vii.) 3. The advice of Origen to pray towards the eastern climate, as denoting our diligence in the service of God, in being more forward to arise and set about it than the sun is to run its daily course, for which he produces the authority of an Apocryphal text, Wisdom, xvi. 28. (Orig. De Orat. § 20.) 4. The opinion they entertained of the excellence of this quarter above others. (Orig. De Orat. § 21.) The congregation being thus turned towards the east, they put themselves into a posture of prayer, stretching out their hands, and lifting up their eyes towards heaven. (Clem. Alex. Stromat. lib. vii. Tertull. Apolog. c. 30.) The minister then began to pray, his usual garb being a pallium, or, as we call it, a cloak; which was deemed a more simple and plain garment than the toga, which was used through the whole Roman empire. But it does not appear from any authority of ancient writers, that they put a furplice or any other kind of linen garment over their cloaks. The prayer was pronounced, as Cyprian says (De Orat. Domin. § 2.), with a modest and bafhiell voice, that being most proper for those who came to acknowledge the multitude and heinousness of their sins, and to beg God’s pardon and grace, which is the end and design of prayer. The people did not vocally join with the minister in the prayers, but...
but satisfied themselves with telling their affront to what he expressed, by saying Amen, or so be it. Indeed it was impossible for the people to respond, since they had no fixed public form of prayer, except the Lord’s prayer, which they freely, though not always, repeated; and as to their other prayers, every bishop or minister of a parish was left to his own liberty or ability therein. The constant repetition of the Lord’s prayer with other prayers was not thought to be necessary, but it was frequently omitted. Accordingly they regarded the Lord’s prayer as given by Christ for a pattern of all other prayers, so that Cyprian (De Unit. Eccl. § 11.) calls it the law or rule of praying. But though the repetition of the Lord’s prayer was not necessary, yet it was usual. Although they used that, they had also other prayers. Their usual method, according to Tertullian (De Orat.), seems to have been, first to begin with the Lord’s prayer, as the ground and foundation of all others, and then, according to their circumstances and conditions, as he expresses it, to offer up their own prayers and requests. These other prayers, however, were not restricted or imposed forms; but the words and expressions of them were left to the prudence, choice, and judgment of every particular bishop or minister. In other words, the primitive Christians had no fixed liturgies, or imposed forms of prayer. As to prescribed forms, there is not the least mention of them in any of the primitive writings, nor the least word or syllable tending to it, according to lord King, which, as he says, is an unaccountable silence if there ever were such, but rather some expressions intimating the contrary; such as the minister’s praying ὅτι ἡμένα, according to his ability. (Juft. Mart. Apol. ii. Orig. Comment. in Matth. et in Johann.) The noble author now cited has shewn from parallel passages, that the minister’s praying ὅτι ἡμένα, or according to the utmost of his ability, imports the exercise of his gifts and parts in suitable matter and apt expressions; and that the primitive prayers were such appears farther from a passage in Origen, which explains the verfe in Matth. vi. “When ye pray, use not mere repetitions, &c.” It is very unlikely, continues his lordship, that they were obliged to preformed forms, because they never read a syllable of their prayers out of any book whatever; which is evident from their posture of prayer, that was two-fold, either with their hands and eyes lifted up to heaven, or with their eyes shut. (Tertull. de Orat. Origine in Matth. vi. § De Orat, § 9. Contra Celsum, lib. vii.) If they had used preformed and imposed forms, they must necessarily have remembered them, which would have been an intolerable load to the strongest memory; especially to have repeated, word after word, the prayers of their fast-days, which must have been several hours long, since some of their fasts were prolonged from the morning of one day to the beginning of another. Whether their prayers were divided into several collections, our author has not been able positively to determine; but he thinks it probable, that on their fast-days they made several distinct prayers, and that at their ordinary meetings, their prayer after sermon was but one entire piece. According to Juft. Martyr (Apol. ii.), the prayer that preceded the confirmation of the eucharistic elements “was one long prayer, to which the people said, Amen.” Lord King’s Enquiry into the Constitution, Discipline, Unity, and Worship of the Primitive Church, part ii. See LITURGY.

WORLEY, in Geography, a populous township in the parish of Eccles, and county of Lancaster, England, 6 miles W.N.W. from the town of Manchester. In the year 1811, this place contained 6151 inhabitants, who occupied 1012 houses; and nearly the whole of whom were engaged in manufactures and the coal-mines. At this place is the famous tunnel for the Bridgewater canal, (see CANAL,) and a large brick manufactory, called Worsley-hall, which belonged to, and was inhabited by, the late duke of Bridgewater. See Lancashire Gazetteer, 1808.

WORSTED, or WORSTEEDE, a market-town in the hundred of Tunstead, and county of Norfolk, England, is situated 4 miles S.S.E. from North Waltham, and 120 miles N.E. by N. from London. It was formerly a place of much celebrity, and of considerable trade; but is now greatly on the decline, and is chiefly remarkable for the invention, or first twilling, of that fort of woollen yarn or thread, which hence obtained the name of worsted. This manufacture is mentioned in the second year of Edward III. when the weavers and workers of worsted stuffs were required by parliament to work them in a better manner than they had previously done. These stuffs, and knit and woven hose, constitute the chief manufacture of the town. A weekly market is held on Saturdays, and here is an annual fair. The church consists of a nave, two aisles, a chancel, and a square tower. The population of the parish, according to the return of the year 1811, amounted to 619, occupying 112 houses.


Worsted, and WORSTEEDE. The term worsted is applied to yarn, and manufactured goods made of combed wool. Worsted is properly a branch of the Woollen Manufacture, to which article we refer our readers; but the latter term, strictly speaking, is applied only to yarn, or pieces made entirely or in part of carded wool. The characteristic distinction between combing-wool and short or clothing-wool has been already stated under the article Wool. (See WOOL and WOOLEN MANUFACTURE.) Worsted goods were made in England as early as the time of Edward II. In the account of exports in the following reign, already given in the article Woollen Manufacture, the number of pieces of worsted goods exported is nearly double that of woollen cloths. According to Camden, the name is derived from Worsted, a town in Norfolk, where worsted stuffs were first made. According to Dr. Parry, in his “Effay on the Merino Breed of Sheep,” worsted was called by the Flemings ‘Ofaede,’ and as the manufacture was in their hands long before it was introduced into England, it is probable that our appellation is a corruption of their’s. Ofaede was long ago a common surname in Flanders, and was perhaps that of some person famous for this particular branch of the woollen trade, which afterwards was appropriated to an establishment of similar manufacturers in Norfolk.

Worsted yarn is made of long or combing-wool, in which the fibres are all laid even parallel with each other by the wool-comb. It may be classified into two great divisions, the soft and the hard worsted yarn. The soft yarn is made of the shorter kinds of combing-wool, the sorting of which has been already described under the article Wool. The short and long combing-wools are both prepared for spinning by the comb in the same manner, except that for some kinds of fine hard yarn made from the latter, the wool is combed, and afterwards spun nearly without oil. This is the case with the yarn for bombazines. The soft yarn for hosiery receives but little twist in the spinning, and two, three, or more threads are afterwards twisted together on what is called a doubling-mill, to make a thread of requisite strength and thickness to be woven on the stocking-frame. See STOCKING-FRAME.
WORSTED MANUFACTURE.

Knitting-yarn is twined much harder than yarn for the frame. For mixed coloured flockings, part of the wool is dyed and mixed with the white in the process of combing. The principal feats of the worsted hosiery manufacture in England were Nottingham and Leicesters; but of late years the worsted hosiery has declined at the former place, the trade there being principally confined to silk and cotton articles. Formerly hosiery comprised a variety of worsted articles, particularly caps, which were generally worn in England before the introduction of hats.

At Aberdeen, in Scotland, there is a considerable manufacture of hosiery, the wool being principally supplied from London. Worsted flockings, and lamb's-wool hosiery, to the amount of from fifty to seventy thousand pounds, are laid to have been annually exported from Aberdeen to Holland. Of the number of hands employed in worsted hosiery in Scotland, the annual value of the goods made, we have no correct account. Perhaps some estimate may be formed from the amount of exports of woollen hosiery given under the head Woollen Manufacture, in the table of exports, in which it will be seen, that in the year 1786 the worsted hosiery exported amounted to one hundred and forty-one thousand and fifty pounds. This, we believe, includes the hosiery made of woollen yarn, or what is generally called lamb's-wool yarn, an article which, since the beginning of the present century, has been greatly increasing in demand. Soft worsted yarn for hosiery, during the last twenty years, has been principally spun and doubled by machines in large worsted-mills. Previously to that time, worsted-making by hand-spinning was a distinct trade from hosiery. The worsted-maker bought his different sorts of combing-wool from the wool-flapper, combed and spun it, and sold the yarn to the hosiery. Since then, the hosiery have been principally supplied with worsted yarn from large mills established in Leicestshire, Nottinghamshire, and Warwicksire. Of late, however, many of the hosiery are manufacturing their own yarn on machines or mules turned by the hand, or in small mills turned by horses or water.

The combing-wools of Kent are better suited for hosiery worsted yarn than any other in England, particularly for machine-spinning. This excellence is derived partly from the fowtnets as well as foundeens of the wool; but particularly from the flake being nearly of uniform thickness from the bottom to the top. See Wool.

Picardy and Normandy were the principal feats of the worsted hosiery in France. Under the article Woollen Manufacture, it will be seen that 1,250,000 pounds weight of wool were consumed annually in the manufacture of hosiery in Picardy before the French revolution.

The flocking-frame was invented by William Lee, M.A. of Cambridge, in 1589, and was afterwards introduced into France. This invention took place in England only 28 years after the knitting of hosiery yarn on needles had been introduced from Spain. See Stocking-Frame.

Hard worsted yarn for worsted stuffs or pieces is spun much smaller, and twisted much harder, than the soft worsted yarn for hosiery. In all the flouter kinds of worsted goods, the long or heavy combing-wool is used. (See Wool.) Under the article Woollen Manufacture we have noticed the introduction of the worsted trade into England, and various places where it was first established. Norwich and some of the towns in Norfolk and Suffolk appear to have been the first where any considerable quantity of worsted pieces or stuffs were made. The names which the different kinds of worsted pieces have received are very numerous, being often derived from the manufacturer who introduced a flight change either in the mode of weaving or finishing the goods. These names soon became obsolete, being supplanted by other kinds of worsted goods, so that we do not know at present to what particular kind of pieces some of them were formerly applied; the essential difference confining in their being woven plain, twilled, or figured, or made with a warp of single or doubled yarn, and woven flouter or more lightly, or of greater or less width, and whether they were glazed or not in the finishing. The most important distinction between worsted pieces and woollen cloth consists in the former not being milled or raised, as to cover the surface with a pile, but the thread is left bare. To take off the loose hairs which rise from the surface, the worsted pieces are passed over a red-hot cylinder, in the same manner as many kinds of cotton (see Cotton Manufacture): this process is called fingering. For some particular purposes, a light degree of milling has recently been attempted to be given to worsted pieces in the fulling-mill. The glazing communicated to some kinds of worsted goods is given by pressing them between sheets of felt glazed prefs-paper and heated iron plates, which are compressed in a strong press-frame. The weaving of figured pieces, see Weaving, and Draught of Looms.

Some kinds of very fine worsted goods are made with a warp of mohair or silk, as silk camlets and bombazines. The latter goods, with a silk warp and wefted with hard worsted yarn of the finest kind, are manufactured at Norwich. The term bombazine appears to be derived from bombycina, a kind of silk drefs used by the Romans, and said to come from Assyria. It is generally understood to have been made from the threads of an insect called the bombyx. Bombycina is sometimes confounded by commentators with byssinum and sericum. Byssinum appears to have been a very fine kind of linen or lace; sericum unquestionably means fliken stuff, so called from the Seres, the nation whence it was procured. Probably bombycina was a coarser kind of silk. In the middle ages, the word bombycina was applied to cotton. Macpherson's Annals of Commerce. See Byssus.

Bombazines are woven with a twill, and have, as before flated, a warp of silk and a weft of fine worsted yarn. The Dutch refugees, who fled from the persecution of the duke of Alva, introduced the manufacture of this article into Norwich in the year 1675, when the Dutch elders, according to Blomefield, presented bombazines in court at Norwich. (Blomefield's Hist. of Norfolk, vol. ii. p. 255.) Worsted goods were made in Norwich as early as the reign of Edward II. This appears from a patent granted to John Peacock, for the measuring every piece of worsted made in the city of Norwich or county of Norfolk. Norwich has continued from that time one of the principal feats of the worsted and stuff trade. The sale of stuffs made in Norwich only, in the reign of Henry VIII., amounted to 100,000l. annually, besides worsted flockings, which were computed at 50,000l.

Norwich is at this day the only part of England where any considerable number of the very finest stuffs and bombazines are made. The manufacture of the coarser kinds of worsteds, except camlets, has been transferred in a great measure into Yorkshire. The period preceding the American revolution, from the year 1743 to 1763, may perhaps be regarded as the most flourishing era of the worsted manufactures of Norwich. According to the account of Arthur Young in 1771, the manufactures of this place had increased four-fold in the preceding 70 years. The number of looms was then estimated at 12,000, and each loom was supposed to employ six persons in preparing and finishing the
the material; and the total annual value of the goods was estimated at above £1,200,000. Of these goods the estimate then was,

<table>
<thead>
<tr>
<th>Destination</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotterdam</td>
<td>£480,000</td>
</tr>
<tr>
<td>to London</td>
<td>£550,000</td>
</tr>
<tr>
<td>to various places</td>
<td>£200,000</td>
</tr>
<tr>
<td><strong>Total value</strong></td>
<td><strong>£1,230,000</strong></td>
</tr>
</tbody>
</table>

The number of persons employed being from seventy to eighty thousand.

Since the time to which Arthur Young refers, the manufacturers of Norwich have engaged extensively in the trade of silk shawls and other articles, in which no worsted whatever is used. Still, however, the worsted manufactures of Norwich may be considered as in a flourishing state. The number of looms employed in worsted at the present time (1818) may be estimated at 10,000; half of which weave camlets, calimancoes, and other stuffs; and the other half bombazines, narrow and broad. The former are chiefly for home consumption, the latter for the Spanish market. The East India company take a considerable quantity of the fine camlets manufactured at Norwich.

By far the greatest part of the worsted yarn employed at Norwich is supplied by machine-spinning, from the worsted-mills in Yorkshire, Lancashire, and Durham. But some yarn still continues to be spun in the old manner, by the running-wheel, in Suffolk, Essex, Hertfordshire, and Cambridgeshire. In Norfolk alone, the use of the distaff still remains. This instrument is the most ancient of which we have any notice, either in sacred history, or the fabulous traditions of Grecian mythology handed down to us by Homer and Hesiod. It is at present vulgarly called the rock. In using it, the thread is drawn out from the end of the flax of combed wool. The motion is communicated to a rough kind of spindle, by twirling it between the right-hand and the thigh, which is suffered to continue revolving when suspended by the thread, which the spinners gradually lengths with their fingers.

In wheel-spinning, a small portion of the combed wool or flax is laid across the fingers, from the centre of which, called the twist, the thread is drawn out. About thirty years since, the counties of Norfolk, Suffolk, Hertfordshire, and Essex, not only supplied all the yarn that was wanted for the manufactures of those districts, but sent large quantities of worsted yarn to Halifax and Manchester. At present the trade is completely turned, and, as we have before stated, the greater part of the yarn used at Norwich is sent from the northern counties of England. This change has occasioned great distress in the villages where the worsted trade was formerly carried on, by depriving the wives and children of the cottagers of their common employment.

Until the middle of the last century, worsted goods were manufactured in considerable quantities in Warwickshire, Oxfordshire, and Northamptonshire; but about that time the extension of the worsted trade in the West Riding of Yorkshire, particularly at Halifax, Bradford, and Wakefield, gradually drew this trade in a great measure away from those counties. The manufacturers in Yorkshire, or rather the merchants who bought the worsted pieces from the manufacturers, were, however, long unacquainted with the best modes of dyeing and dressing them; they were therefore sent to London or Coventry to be finished, but afterwards they were finished in Yorkshire. The demand to Spain, Portugal, Italy, and the Levant, took off the greater part of the worsted goods manufactured at Halifax; those manufactured round Wakefield and Bradford, consisting chiefly of tammies and shalloons, were consumed principally by England and her colonies. The Piece-hall at Halifax was first opened about the year 1780; and the intervening time, from thence to the year 1792, or the breaking out of the French war, may be regarded as the most flourishing era of the worsted trade in Yorkshire. Though the cheapeens of calicoes, as an article of female drefs, since the improvements in the cotton manufacture, materially abridged the sole for some kinds of worsted goods in England, this was more than compensated by the increased demand for carpets with worsted warps, and other articles of luxury, in which worsted yarn was employed.

The demand in foreign markets, from the year 1782 to 1792, for English worsted goods, greatly exceeded that of any former period; but after the breaking out of the French war, the worsted trade at Halifax began to decline. The greater part of the foreign markets being closed against us, most of the mercantile houses engaged in the export of worsted pieces were in consequence ruined or declined; the trade altogether, and many of the small manufacturers, engaging in the cotton trade. The introduction of English calicoes into Turkey and other parts tended also to lessen the regular demand for shalloons and other worsted goods, as articles of female drefs, in those countries. Soon after the breaking out of the French war in 1792, the spinning of worsted by machinery was established at Bradford and the vicinity; and continuing to increase, drew round that place the manufacturers of worsted goods on the decline of the Halifax trade. Bradford is now become the principal seat of the worsted manufacture in Yorkshire; and some of the proprietors of the worsted mills, besides supplying the smaller manufacturers with yarn, employ a very great number of looms themselves, and carry on this branch of trade on a scale of extent never before known in the worsted manufacture. Within the last two years, the worsted trade has also greatly revived at Halifax.

The following are the kinds of worsted pieces at present principally made in Yorkshire.

**Bombazets** are woven both plain and twilled, with the warp of single thread; they were prefixed, and finished without glazing; the width 22 inches, length 29 yards.

**Tammies**, or durants, with single warps twilled, and generally coarser than twilled bombazets: width from 32 to 36 inches, length 29 yards.

**Shalloons** are woven with a twill, and have a warp of single thread. We believe the name was derived from Châlons in France. The pieces are from 32 to 36 inches wide, and 29 yards long.

**Cubics** are very fine shalloons so called.

**Sayes**, or andacettes, are twilled and made with single warps; they are of two kinds, one running 27 inches wide and 30 yards in length, the other 42 inches in width and 44 yards in length.

**Moorens** are woven plain and watered or embossed, and are made very stout, being principally used for furniture: their width is 28 inches, length 24 yards.

**Calimancoes** are woven plain and striped: width 17 inches, length 29 yards.

**Camlets** are both plain and twilled: width 18 inches, length 29 yards. They are shorter than bombazets, but not many are made in Yorkshire with doubled warps.

**Laflings** have doubled warps, sometimes of two and sometimes of three threads, and are made with great variety of patterns, either plain, twilled, or flowered, and are distinguished by different names, according to their figures and quality.
WORSTED MANUFACTURE.

quality; as prunelle, amens, (probably from Amiens in France, where they were manufactured,) and drawboys: the width 18 inches, length 30 yards.

Worsted shag, or velvet woven like corduroi and cut, is made principally at Banbury, in Oxfordshire, and at Coventry; but has been manufactured also in Yorkshire.

In the worsted manufactures of France, there were greater varieties of pieces than in England. One kind of camlet, made with a fine warp from the wool of the Angora goat and a weft of fine worsted, was remarkably beautiful; but we believe it has not been manufactured in Yorkshire or at Norwich.

For some account of the worsted manufactures of France, see Woollen Manufacture; under which article we have given the history of the worsted manufacture as connected with the woolen, and where may be seen the number and value of the worsted pieces exported from England in the year ending January 1817. See also long combing-wool, under the article Wool.

Worsted Spinning. In the article Wool we have given an account of the different kinds of long wool which are proper for spinning into worsted, also the manner of sorting and scouring them. This wool must be prepared for spinning by repeated combings, with a comb or heckle that is provided with a great number of long steel pins which are sharp-pointed. These points being few in number compared with the teeth of cards, they can be safely introduced between and drawn through the long fibres of the wool, in order to separate and straighten them, without materially breaking them. Another object of the combing is, to separate the short fibres which are intermixed with the long ones; for in spinning any kind of thread, it is desirable that the fibres should be as nearly as possible of a length.

Wool-combing.—In the ordinary process of wool-combing by hand, the implements used are, 1. Two combs for each workman. 2. A poft, to which either of the combs can be fixed, to support them during the operation. 3. A comb-pot, which is a small flat to heat the teeth of the combs, which is found to facilitate the combing. The combs are shown at fig. 1. Plate 1. Woollen Manufacture: each comb is composed of two rows of pointed steel teeth, and fixed in two parallel planes. One of the rows contains longer teeth than the other. They are fixed into a wooden stock or head c, which is covered with horn, and has a handle d fixed into it, perpendicular to the planes of the rows of teeth. The rows of teeth are about seven inches long, and each row contains about twenty-four teeth. The length of the longest teeth is near twelve inches, and the shorter ones about eight inches. The teeth are made of steel, of a round figure, and regularly tapering from the base, where they are fixed into the stock, to the point, which is quite sharp. The teeth are about one-fifteenth of an inch in diameter at the base; and the interval between the two adjacent teeth at the base is rather less than their diameter, or one-eighth of an inch. The space between the two planes in which the teeth are disposed is about one-third of an inch at the bases of the teeth. The teeth should be straight and well-tempered, and polished. If they become crooked in working, the workman must straighten them, and let them all in a true line. The combs used for the last combing of the wool have three rows of teeth.

In the wool-comber’s shop a poft is fixed, as shown by fig. 2, in order to support the combs occasionally during the working. An iron ring g is fixed fast into the poft, and projects horizontally from it; the extreme end of it turns upwards with a point, which is inserted into a hole through the middle of the handle of the comb. Also at the other end of the item g, close to the poft, there is a small hook h riveted, which terminates with a pointed pin, situated in an horizontal direction. This point is inserted into a hole made in the end of the handle of the comb, in the direction of its length. The end of the comb-handle being first placed on the point of the hook h, it is let down upon the other point g, which, by passing through the handle, fixes the comb quite fast to the poft, as shown at fig. 2.

In the operation of combing wool, it is necessary to heat the teeth of the combs, in order to soften and relax the fibres of the wool, and render them more easy to work. The heat also tends to distribute the oil with which the wool is lubricated. The combs are heated in a comb-pot or flue, fig. 3, which is a small furnace built in brick, to inclose a fire-place, of which A is the door, B the ash-pit, and C the flue. Above the fire a circular cast-iron plate a a is placed. This is made flat, except in the central part, where there is a concavity, to obtain a better action of the fire. Immediately over the plate a, another plate, b b, is placed parallel to the former, but with a sufficient space between them to admit the teeth of the combs; several pieces of iron are placed between the two plates, to keep them at a proper distance aunder, and to divide the space into small cells proper for the combs.

In using this flue, the workman must be careful not to heat it too much, and a damper in the flue is very useful to regulate the draught; if the heat is too great, it spoils the temper of the comb-teeth, and injures the wool also. The most improved flue is heated by steam, which will give a sufficient warmth, but cannot overheat the comb-teeth.

In order to comb the wool, it is separated into handfuls, each containing near four ounces of wool, which is about a proper quantity to be combed at once. These handfuls are sprinkled with oil, and the wool is rolled in the hands to distribute it equally. The quantity of oil varies from 1/6th to 1/6th of the quantity of wool by weight. The comb is first heated by introducing the teeth into the flue, in one of the cells between the two iron plates; when it has acquired sufficient heat it is withdrawn, and another comb is put in its place. The heated comb is then fastened to the poft, with its teeth pointing upwards, in order to be filled with wool; the comb is then fixed in the flue, and slowly heated by the fire, so that it penetrates it; then by drawing the wool towards him, and at the same time downwards to the bottom of the teeth, a portion of the wool will remain in the teeth. The lock of wool is again cast upon the teeth, and drawn through them, and every time some wool remains; this is repeated as often as is necessary, until all the wool is gathered upon the teeth. The comb thus filled is placed with its points in the flue, and the wool which is upon it remains outside of the flue, but will become slightly warmed. The other comb, which was heating whilst the first was filling, is now filled in turn, in the same manner as the first, and is then put to heat with the wool upon it, and whilst this is going on, the workman occupies himself in making a handful ready for the next combing.

When both combs are properly warmed, the combers hold one of them with his left-hand over his knee, as he is seated on a low stool, and with the other comb held in his right-hand he combs the wool upon the first, by introducing the points of the teeth of one comb into the wool contained in the other, and drawing them through it; this is repeated for 14 or 15 frokes, until the fibres of the wool are separated, disentangled, and laid parallel. In combing, he ci-
rects the combs—sometimes with the teeth of one parallel to
the teeth of the other, and sometimes with the teeth of the
two combs at right angles, or in a close direction; but in
all cases he must take care to begin gradually, by intro-
ducing the points of the teeth, first into the extremity of
the wool which is contained in the teeth of the comb, and
then penetrating deeper into the wool at every succeeding
stroke, till at last he works the combs as near as he possibly
can without actually bringing their teeth in contact: with-
out this precaution, he could not draw the comb through
the wool without breaking the fibres, and tearing the wool
out of the teeth of the comb; but if he proceeds cautiously,
the wool will be disentangled, separated, and straightened.

During the working, he frequently changes the combs,
so as to work the wool upon both combs; but as the
wool will gradually accumulate upon that comb which is
most worked, he manages them so that at the end of about
35 or 40 strokes nearly all the wool will be gathered upon
one of the combs, and will hang from its teeth in a fair
lock of straight and regular wool. This comb he puts to
heat for a moment, then fixes it to the poft, and proceeds
to draw off the wool from the comb in a fiver. To do this,
he takes hold of the wool which projects from the teeth with
the fingers and thumbs of both hands, and draws it away
from the teeth of the comb in a direction perpendicular to
their length, without fiding it off their points: as the wool
comes away, he takes freth hold, always feizing the wool at
a given distance from the teeth. A portion of the wool which
consists of short fibres will not come off, because it does
not reach to the place where the comb grasps the wool;
it therefore remains in the teeth of the comb, and is drawn
off afterwards. This short wool, which is called noil, is
 unfit for worsted fpinning; it is composed in part of the
short fibres which are naturally intermixed in the long ones,
and also of the fragments of long fibres which are broken
in the procefs of combing. The quantity of the noil de-
pend upon the kind of wool, and also on the care with which
the comber has conducted his procfs; but it will seldom
exceed 5th or 4th of the quantity of the raw wool by weight.

The wool which is drawn off from the comb forms
a continued filver or band, the fibres of which are
straight and parallel, but not sufficiently so for fpinning; it
is therefore combed over again, and frequently it is repeated
a third time. The firit combing is called hacking, and the
fivers produced by it are extended five together upon a table;
then holding them down with one hand, they are broken
again into handfuls by drawing them with the other.
These are combed again in the manner before defcribed, but
the heat given to the combs is much lefs. The ultimate
fliver, which is drawn off from the comb the laft time,
ought to be very even, and composed of long and parallel
fibres. On examining it against the light, every part should
appear equally dense, without any entanglements of the
fibres, for on these particulars the perfection of the fpinning
will in a great meafure depend.

The combed wool produced from sixteen pounds of wool
usually weighs eleven or eleven and a half pounds, for about
two pounds are loft in washing, and the reft in noil and
waife in the combing. When the combing is finifhed, the
fivers are formed into fix parcels, each containing ten or
eleven fivers, which are rolled up together into a ball, and
ticketed with their weight and quality, the wool-comber’s
mark, and wool-flapier’s mark. In this flate, combed wool
is called tops or Jerfey, and is sold to the fpinners in the
country, and in cottages, who spin it into worked-thread by
the fimple hand fpinning-wheel; but the manufacturers who
spin by machinery have wool-combers

at their mills, and they ufually employ combing-machines
in addition.

Combing-Machines.—The firit combing-machine was in-
vented by the Rev. Edmund Cartwright. His firit two
patents were in 1796, and he had another in 1792; but the
machine was not rendered perfect, or brought into extensive
use, till a later period: and in 1802 he obtained an act of
parliament to renew or extend the term of his patent.
The fpecification which he enrolled in confeguence contains
drawings and defcriptions of machines nearly of the fame
kind as thofe which are now in ufe at many of the great
worsted-mills, and which we shall defcribe. Mr. Cart-
wright propofed to form the raw wool into continued fivers,
by joining the pieces of wool together, and lightly twifling
them, and in this flate they could be prefented to the
combing-machine; but as this plan was not found to fuc-
ceed, it was found neceffary to comb the wool firt by hand,
in order to reduce it to fivers. This is still the common
practife, and takes away great part of the advantage of the
machine; but we have been a preparing-machine for this
purpofe, which operated very well upon the raw wool.
The inventor’s name we have not learned; but the rudif-
ments of it are to be found in Mr. Cartwright’s fpecification
of 1790.

Preparing-Machine.—The raw wool is spread upon a
horizontal feeding-cloth, which is extended over two rollers,
and circulates upon them: by its motion, the wool is carried
forwards, and prefented to a pair of fluted rollers, which
draw it in. This feeding-cloth is situated at the top of
the machine, at the height of about five feet from the floor,
so as to allow room for the reft of the machinery beneath it.

A principal part of the machinery is carried by a ho-
izontal wheel of five feet diameter, which is mounted upon
a vertical axis, and is turned rapidly round by the mill.
This wheel carries four porcupines, which are small cylin-
drical rollers, armed with spikes or teeth rather hooked.
The rollers are situated horizontally in the plane of the
wheel, with their length nearly in the direction of radius.
They are about seven inches in diameter, and fourteen
inches long, and are fixed upon horizontal fpindles, which
proceed from the circumference of the great wheel nearly
to its centre, one extremity of each fpindle being flunct
by the rim of the wheel, and the other in a support fixed
to the perpendicular axis. The porcupines are fixed on the
ends of the fpindles, near the circumference of the wheel,
and on the opposite end of each fpindle is a small cog-wheel
to work in a worm or endless fcrew, which is fixed concentric
with the axis, being cut on the outfe of a hollow tube
through which the vertical axis paffes.

By this means, the four porcupines which the wheel con-
tains have a two-fold motion, viz. they are all carried round
in a circle by the motion of the wheel, and at the fame time
each one has a flow rotative motion on its own axis, in con-
sequence of the cog-wheels, which work in the threads of
the fixed worm.

The feeding-cloth is fo fuated, that the four porcupines
in the great wheel will pafs in fucceffion exactly beneath
the fluted rollers, which take the wool from the feeding-cloth
and the teeth of the four porcupines being fharp-pointed
and rather bent forwards at the points, they penetrate and
catch the wool as it comes through these fluted rollers, and
hang down from them. A portion of wool is thus car-
ried away by each porcupine every time it paffes beneath
the fluted rollers; but by the flow revolving motion of
the porcupines on their own axes, each one prefents a dif-
ferent row of teeth every time, and thus by degrees they
become clothed with the wool which they take up.

This
This wool they deliver to a larger porcupine, which is placed beneath the revolving-wheel, or on the opposite side to the feeding-cloth. This porcupine is a cylindrical nineteen inches diameter, and fourteen inches long: its axis is placed horizontally, and directed nearly to the centre of the vertical axis; so that the small porcupines will be parallel to the large one when they pass over it. The great porcupine is furnished with rows of teeth exactly similar to those of the small ones, which teeth are not very numerous, but large and sharply pointed, and rather hooked, with the points forwards. When the small porcupines pass over the large one, there is so little space between their teeth, that the wool which is contained in the teeth of the small ones will be taken off by the large one, and remain in its teeth. The reason of this is, that the teeth of the large porcupine present themselves to the teeth of the small ones with the points forwards, and the small porcupines at the same time move with the points of their teeth backwards. It was before stated, that the porcupines move with the points forwards when they take the wool from the feeding-rollers, but this wool is applied on the upper side of the porcupines, and the great porcupine is at the lower side; hence the direction of the teeth is reversed in the two cases, and occasions the wool to be given to the great porcupine, a small quantity at a time, from each of the small porcupines, as they pass over it. The great porcupine being turned slowly round upon its axis clothes itself with the wool in a continued fleece, and this is drawn off from its teeth by a pair of fluted rollers, between which it passes in a continued sliver or band; this band is also conducted through a short tube, which revolves round its axis, and rolls up the sliver, to make it adhere better together in a round and compact form.

The action of this machine is not to comb the wool, but to divide the mass of raw wool, which is spread on the feeding-cloth, into a great number of small and equal portions by the successive strokes of the small porcupines; these portions are again mixed together in one film of wool upon the great porcupine, from which the wool is drawn off in a continued sliver, and as much twist is given to it as is requisite to make the sliver sufficiently compact to submit it to the combing-machine.

Cartwright's Combing-Machine, or Combing-Table; called also amongst the workmen Big Ben.—In Plate II. fig. 1. Worsted Spinning, is a horizontal plan of the machine, which exhibits nearly all its parts; we have also given a perspective view in fig. 2. of the operative parts, as they would appear if detached from the framing which sustains them. A is a circular ring of wood, which is fixed down on the framing; B is a similar ring, which is fitted into the fixed ring, with liberty to turn round within it. The interior of this ring is furnished with a row of comb-teeth, with the points directed to the centre, and there are two other rows of shorter teeth beneath, so as to make three circular rows of teeth. This forms a large circular comb, called the combing-table, about five feet diameter; it is moved slowly round in the direction of the arrow by means of a pinion, which works into a ring of coggs, fixed in segments within side of the circular comb beneath the row of teeth, as is shown in the section, fig. 3.

The wool is filled upon the teeth of the circular comb by means of two machines F and G, called crank-lashers. These supply the wool by lashing or throwing the lock of wool upon the teeth of the comb, and then drawing up the wool from the comb, with a motion very similar to that of the hand of the workman in filling the combs, as we have before described. The crank-lashers repeat their strokes with great rapidity; but as the comb-table is kept in continual motion, the wool which is lashed upon the teeth by the first crank-lasher F is carried away, and in its course comes beneath the other crank-lasher G, by which more wool is filled upon the teeth, and they receive the intended portion. This wool, by the rotation of the comb-table, is then carried beneath a small comb K, which works by a crank movement, but with its teeth always horizontal; they penetrate through the wool, and then rise up so as to comb it. After this operation, the wool is taken off from the teeth of the comb-table between a double pair of fluted rollers N, situated immediately over the comb-teeth; these draw off the combed wool in a continued sliver, which is conducted through another pair of plain rollers R, and falls into a tin can placed there to receive it.

This machine was not found capable of combing the raw wool, chiefly because the comb-teeth are not heated, and also because the actions of lashing on the wool, and afterwards combing it, begin to act upon wool, at first with their full force, and break the fibres if they are entangled together; hence it is found best to comb the wool by hand once over, or for fine goods twice. The wool is thus formed into slivers, which are joined together, by laying them on a table, with the ends lapped over each other; and rolling them together, they will join into one long sliver. Three of these slivers are put into tin cans ii, which are placed upon a circular table I, and carried upwards to the crank-lasher F or G, which are both of similar construction. The table I is mounted on an axis, so as to be capable of turning slowly round horizontally, in order to twist the three slivers together into one; but in the machines which we have seen in use, this movement is commonly neglected, for if the slivers are prepared by hand-combings, as we have before described, they will hang together without twirling.

The slivers, which are carried up from the can to the crank-lasher (see fig. 3.), first pass over a roller at e; the axle of this roller is also the fixed centre of motion of a trough H, which forms one part of the crank-lasher. The sliver of wool is conducted along the trough H, and then turns over a second roller at f; the centre-pin of this roller is the joint, which unites the end of the trough H with a moveable frame d, which has a tube g fixed in front for the sliver of wool to pass through. A little below the middle of this frame d are holes through its sides, to receive the pin of a crank k b, of which the central axis is supported in bearing, and screwed to the frame of the machine, and it is turned round by the power of the mill. By means of a pair of bevelled wheels D and E, fig. 1., the cranks of the two crank-lashers are connected together, and have a common motion, but in a direction at right angles to each other. At the lower end of each of the moving frames d d, a pair of fluted rollers i are fixed, which draw the sliver between them. The rollers are put in motion by means of a cog-wheel k, fixed on the extremity of the axis of the lower roller; this is turned by a small pinion, fixed at the end of an axis, which passes through the frame d d, and which at the opposite end has a wheel b, that receives motion from a pinion fixed fast to the pin of the crank. The upper of the two fluted rollers is pressed down against the lower one by springs, which bear on its pivots with sufficient force to hold the wool firmly between them, and draw the sliver forwards when they turn round.

The motions of the crank-lasher are not easy to be understood from a verbal description. It must be recollected, that the upper end of the frame d d which carries the rollers, being joined to the end of the trough H, it must always move in the arch of a circle, as shown by the dotted lines, fig. 3; the centre of this arch is c; also that the middle part of the frame d, where the crank-pin passes through
it, must describe a circle when the crank revolves: in consequence, the rollers, which are at the lower end of the frame, will move in a curve, as shown by the dotted lines. It is an oval or distorted ellipse, with the longest diameter horizontal.

At the same time the fluted rollers circulate in this orbit, they are in continual motion on their own axis, by the communication of wheel-work before described, and they draw the fliver of wool down the tube g; the end of the fliver, which projects from below the rollers, hangs down from them in a lock, and by the motion of the crank-lathe this is thrown against the points of the teeth in the comb-table. At the period when the wool is thus thrown on the teeth, the rollers are moving nearly in an horizontal direction, so as to draw the wool in the direction of the length of the teeth, and they penetrate the wool; but as the rollers proceed in their elliptic orbit, they begin to rise and draw the wool upwards away from the teeth in an inclined direction, as is evident by tracing the dotted course marked out for the rollers. By thus drawing up the wool between the teeth, a portion of the wool will be left in them; the rollers then rise up rapidly in their oval course, and the wool is raised quite above the teeth; the rollers then move forwards to make another stroke, and during such advance, the rollers, being in continual motion, draw forwards the fliver of wool, and the end hangs down ready to be lashed on the teeth of the comb next time.

The motions of the small comb K must be next described. The whole machine receives its motion by means of a wheel or pulley c, fig. 1., upon the axis of the crank for the lathe G; D and E are the bevelled wheels by which the other crank is turned; at the extreme end of the axis C is a pinion, which turns a bevelled wheel L, and on the axis of this is a wheel turning two others M M of equal size; on the extremities of the axes of the wheels M M are two cranks II of equal radii, which are both jointed to an iron bar mm, and both turning round together in the same direction, they cause the bar to move in a direction parallel to itself, and every part of the bar describes a circle equal to the radius of the cranks. The small comb K is fixed to this bar, and partakes of its motion, whereby the points of its teeth are carried horizontally into the wool contained in the teeth of the great comb, then rise upwards and draw through the fibres, in order to comb them.

In order to remove the little comb when it becomes filled with wool, it is attached to the bar m by means of a comb-holder or socket L, which has a groove at each end to receive the little comb, and it can be mounted or withdrawn at pleasure. This socket L is moveable upon a horizontal pin fixed at the end of the bar m, so that it can be turned with either end upwards; and as the little comb can be fixed at either end of the socket, a spare comb is placed in the upper groove of the socket, whilst the lower groove holds the comb which is in use; but when this becomes filled with wool, which it has gathered from the comb-table, the socket L is inverted by turning it half round upon its centre-pin, and by this means the fresh comb is brought down into use, and the other can be taken away to clear off the wool from it. There is a small bolt fixed to the pin on which the socket L turns, which can be shot into a notch when the socket is in a perpendicular position, and will then hold the socket fast from turning, and keep the comb in a proper position for its work. In this way, the little comb can be taken away and replaced by a fresh one as often as is necessary, without stopping the machine, for the small comb does not move very quick. The same boy who attends to change the combs, when necessary, also sets up the wool in the great comb-tooth with a small scraper, so that the small comb will penetrate through it with more certainty and effect. The plane of the rows of teeth in the small comb is not horizontal, or parallel to the teeth of the combing-table, but inclined thereto, so that those teeth of the small comb which first come into action upon the wool do not penetrate deeply into it; but as the comb-table turns round, the wool advances beneath the small comb, and is operated upon those teeth which go deeper, and the left teeth of the comb as deep as they can, not to touch the teeth of the comb-table.

The wool is now combed, and only remains to be drawn off in a continued sliver; this is done by the drawing-off rollers N, which are fluted iron rollers, placed horizontally over the comb-teeth, and nearly in the direction of a radius of the comb-table: they are supported in an iron frame, and are turned round by a pair of bevelled wheels from a vertical axis P. This axis extends the whole height of the machine, and is put in motion by means of a pair of bevelled wheels, and an oblique axis Q, which is turned by a bevelled wheel and pinion on the extreme end of the axis of the first crank-lathe.

The great comb receives its motion from the perpendicular axis P, which turns a large wheel T by a pinion on the lower end of it; on the upper end of the axis of this wheel is the pinion which works in the ring of teeth within side of the comb-table: in this way, a very slow motion is given to the comb-table. There are two pairs of drawing-off rollers N, situated close together, and parallel to each other; the first pair are put in motion as we have described, and the back pair are turned by means of equal cog-wheels, so that they move with the same velocity.

The wool upon the comb-table is gathered in the hand, to form a sliver, and the end is introduced between the rollers, which continually draw off the wool as the comb-table turns round. After passing through both pairs of rollers, the sliver is conducted through a forked iron, then through a round wooden tube, and is at last delivered by two plain wooden rollers R into a tin can placed beneath, to receive it. These rollers are also turned by bevelled wheels on the perpendicular axis P. The drawing-off rollers only take away the long wool, the fibres of which are long enough to reach to the rollers. The two rollers compounding the front pair of drawing-off rollers are not placed immediately over each other, but the upper roller overhangs the lower one, so that the plane in which the axes of the upper and lower rollers are both situated is inclined at about an angle of 45 degrees to the plane of the comb-table: by this means, the wool is drawn off from the comb, at an angle of 45 degrees, to pass between the rollers.

The noils, i.e. the short wool and broken fibres, which will not reach the drawing-off rollers, remain in the teeth of the comb-table, and also as much of the long wool as is on the lower side of the comb, and these are called backings: both are taken off by a boy, who is seated for that purpose within the circle of the comb-table; he first draws off the backings from beneath the comb, and then, with one hand above the teeth, and the other below, he draws off the noils.

These two forts of wool are handed to a boy on the outside of the machine, who puts them into separate boxes. The backings are filled on the small combs before they are put into the machine, and become somewhat combed by the action of the small comb: when the small combs are removed from the machine, the wool upon them is further combed by hand, and then drawn off from them in a continued sliver, by means of an additional piece of machinery, which is at the side of the machine.
This combing-machine is found to break the fibre of the wool, and it increases the quantity of wool very much, unless the wool is previously combed once or twice by hand; and as it then becomes only a substitute for the second or third combing, it saves little or no expense. The advantage of the machine is found, in the great regularity and equality of the fibres which is produced by it, a circumstance of particular importance for fine spinning. In combing by hand when the fibre is drawn off, those fibres which the comber first takes hold of are longer than the others; then as the fibre continues to be drawn, shorter fibres are found in it, and the shortest are left of all. These are called the long and short ends of the fibre; the short end is always marked by twisting or rolling it up, in order that when the fibres are joined together into one for spinning, the long and short ends may be equally intermixed and dispersed throughout the whole length. In drawing off the wool from the combing-machine, the long and short fibres are intermixed and taken up together, so that the fibre is of very equal texture.

There have been several other attempts to make combing-machines which deference notice, though they have not come into use.

Messrs. Wright and Hawkley had a patent in 1792 for a combing-machine; and Mr. Toplis of Cuckney had also a patent of the same date, which contains some good ideas. Mr. Hawkley, in 1797, had a patent for improvements on Cartwright's; the principal one was, to make the combing-machine by the combination of a number of small combs, which could readily be applied to the table, or detached at pleasure. If this would allow the combs to be heated, as the inventor proposed, they would work much better.

Mr. Amott had a patent in 1795, and Mr. Pearce in 1798; after this time, Mr. Cartwright's machines had received some improvements from Mr. Hawkley, and came into use; and we find less speculation on the subject.

Gilpin's Combing-Machine.—In 1811, Mr. George Gilpin of Sheffield perfected a very ingenious machine, which combed the raw wool in a molten complete manner. We do not hear that this machine is yet come into use, although we have no doubt of its answoring the purpose, having frequently examined it while at work: it only fault was a complication of parts, which might be easily removed.

The outline of this machine is taken from that of Mr. Toplis in 1793, but is very much improved and perfected. Fig. 4. of Plate I. Worlded, is a sketch of the principal parts. The machine works with eight combs at once, which are of rather larger size than the ordinary hand-combs, the rows of teeth being twenty inches long. These combs are fixed upon two reels or frames A, B, which revolve upon their axles by the power of the mill; our combs, D and E, are fixed upon each reel, and in each position that both ends of the comb-teeth, viz. the points and roots, are equally distant from the centre of the reel to which they are fixed; and the combs, with the combs fixed upon them, form two revolving wheels or frames. The combs D and E are so made, that they can be detached from the reels, or replaced and fixed fast in a moment, by the attendants; and they can, therefore, be heated in a stove, in the same manner as the hand-combs. The wool is also filled upon the combs by hand, and the combs and wool are heated in the usual manner before they are put into the machine, in order to comb the wool.

One of these reels A is firmly turned upon its axis, but the other reel B has a curious compound motion given to it by the machinery: thus it revolves on its own axis; but the axis also advances to, and recedes from, the other reel with a motion parallel to itself, which is repeated four times in every revolution. Whilst B advances towards A, it moves with only one-third of the velocity with which it returns from A. The advancing movement is of a limited and constant extent; but at the same time, there is a third movement which regulates this extent, so that at every succeeding stroke which the machine makes, the two reels will approach nearer together.

Suppose all the combs filled with wool, and mounted in their places upon the reels, the machine is then put in motion, and the two reels A and B turning round in opposite directions, their combs D and E meet each other; and by the compound movement of B, (viz. advancing slowly towards A, and turning round at the same time,) the combs D and E approach in such a manner, that the points of each comb penetrate the wool which is in the other comb, and this is reciprocal of both combs. When the teeth are, thus entered into the wool, the moveable reel B retreats quickly from the other, and the teeth, by drawing through the wool, comb and separate its fibres.

The circular motion of both reels is not regular and equitable, but is communicated by means of elliptical cog-wheels, which occasion the reels to move round very slowly, at the moment when the comb of the reel B is drawing out or combing the wool; but this motion being finished, the reels begin to turn round more rapidly, and at the same time the reel B approaches towards A with a slow movement, in order to present another pair of combs to each other, which meet; and each one penetrates the wool which is upon the other, and then the reel B draws out to comb it, in the manner before described.

In this way they continue to make successive strokes, until the wool is sufficiently combed: the machine is then stopped, and the combs taken off one by one, to be replaced by others, which are filled with fresh wool, and properly heated.

There is likewise another movement of the reel A, which we have not yet mentioned: the axis of that reel has a slow motion backwards and forwards, and in the direction of its length, for a short distance. The intention of this is, that the same parts of the combs shall never come opposite to each other at two successive strokes.

It should be observed, that when the machine is first let to work, the combs at their point of meeting do not come within three or four inches of each other, and the points only penetrate amongst the longest fibres of the wool upon the combs; but at every stroke which is made, the combs advance nearer together, and take deeper into the wool, until, after a certain number of strokes are made, the combs approach as near as they can without touching. They continue to work, in this manner for some time, and when the intended number of strokes is made, a bell rings as an indication that the machine should be stopped. This is done by drawing a lever, and in consequence the machine will stop itself in the exact position for changing one of the combs on each reel. These are removed, and others ready filled with wool and heated are put on in their places, which being done on both reels in the same time by two persons, is only the work of a moment. The machine is then put in motion again, but by the machinery it will stop itself again at the required position for changing the next pair of combs; it is then put forwards, and so on, until all the eight combs are changed.

The combs which are removed from the machine are put into the stove to heat for a few moments, and then the wool is drawn off from them by a separate machine. The head of the comb is here placed in a perp dicular groove, so that its teeth stand horizontal; and a piece of
of metal, which is fixed to the head of the comb, and projects therefrom like a tooth, enters into the spiral groove of a screw, which stands in a perpendicular position, and is continually turned round by the machinery. By this means, the comb is regularly and slowly let down in the groove, from top to bottom. A pair of fluted rollers is placed horizontally, and parallel to the teeth of the comb, in such a position that the comb, in descending, will pass with its teeth at a proper distance from them, to draw off the wool in a layer. After passing through these fluted rollers, the layer is conducted through a perpendicular revolving tube, which gives a roundness to it, the same as it would acquire by being rolled between the hands, and then it is conducted between a pair of plain rollers, which deliver it into a tin can placed before the machine.

A wooden roller is placed above the fluted rollers, with eight pieces of board projecting from it in the direction of radii. When the roller turns round, these boards act to stroke the wool upon the comb, and raise it into a proper situation to be drawn off by the fluted rollers.

The combs are prepared for drawing off the wool, by heating them as before mentioned, and by sliding the wool from the roots of the teeth half way towards their points. In this state, the combs are carried one by one to the drawing-off machine, and the head of one comb is put into the top of the perpendicular groove: it will be prevented from falling down in the groove by the projecting tooth, which enters the spiral groove of the perpendicular screw. The wool is gathered up and introduced between the fluted rollers; the machine is then put in motion, and by means of the screw the comb is gradually lowered down, and the wool is drawn off from it in a layer, which is rolled up into a compact form by the revolving tube, through which it passes, and is delivered into the can by the plain rollers.

The attendant holds another comb ready to follow the first, and when the first has descended to a certain point, he lifts the next comb into the perpendicular groove, so that it rests upon the former, and the wool upon the two combs joins as it were in one. The stroker, when they pass before it, lays the fibres one all way, and the wool is drawn off by the rollers in a continued layer, which does not prevent the slightest appearance of joinings. Another comb is then put in, and the wool joins to the former, and so on. The backings, or wool at the back of the comb, are drawn off by the boy stationed behind the machine; and the combs, as they come through below, are received by boys, who afterwards take away the noil or short wool which remains in the teeth, and then put the combs back into the stove to heat them, ready to be filled again, in order to proceed with another combing. When the wool of all the eight combs is drawn off, the motion of the drawing-off machine is stopped at the moment when the eighth or last comb has descended half way through its course. In this state, the machine waits till another combing is finished, and then the succeeding comb being placed on the top of that one which continues in the machine, the continuity of the layer will be preserved.

The inventor of this machine states in his specification, that for common work the wool only requires to be operated upon once by the combing-machine; and in that case, the machine must be adapted to make twenty-four strokes of each pair of combs before the bell rings. For medium work, such as would require to be combed twice over, in the usual manner of hand-combing, it must be combed twice over by the machine: thus, after having been combed once in the manner before described, the layer of wool is broken up into handfuls, and filled on the combs again by hand as before, and combed over again in a similar manner; but the combs are left heated for the second time of combing. By changing a wheel, the machine should be adapted to make only fourteen or sixteen strokes before it stops, when it is intended to comb twice over. The wool intended for the finest spinning should be combed three times over, and the machine should be set to make fourteen or sixteen strokes of each pair of combs.

The machine has also two different movements for the drawing out of the moveable reel: in one, the motion is over a space of ten inches, and is adapted to comb such wool as is six or eight inches length of staple, and is called wether wool; but by a slight alteration, the execution of the moveable reel can be increased to thirteen inches, and is then adapted to comb hey wool, or wool which is from eight to eleven inches length of staple.

Mr. Gilpin's machine has the advantages of heating the combs and of filling them by hand, both of which are essential to any machine which is proposed to comb the raw wool. The filling is an operation which requires discretion, if it is expected that the long fibres shall be preferred without breaking. The person who fills the wool on the teeth takes a greater or less lock of wool in his hand, according to the condition of it, and the degree of entanglement: also in drawing it between the comb-teeth, the force is proportioned to what the wool will bear. Mr. Gilpin's specification states, that under certain circumstances, when the wool will not wash well, but remains taggy, it is advisable to fill it upon the combs, and slip it off; then fill it again, preparatory for the machine. As the object of this first filling is chiefly to warm the wool, the end may be in part attained by laying the wool upon the top of the stove for a few minutes before it is filled.

**Planking.**—Let us suppose that the wool is combed either by the hand, or by the machine, and we will proceed to explain the means of preparing it into a thread. The combing-machines reduce the wool into a continued layer, which is ready for the drawing-frame; but the short slivers produced by the hand-combing must be first joined together by what is called planking. These slivers are rolled up by the combers, ten or twelve together, in balls called tops, each of which weighs half a pound: at the spinning-mill these are unrolled, and the slivers are laid on a long plank or trough, with the ends lapping over, in order to splice the long end of one sliver into the short end of another. The distinction of the two ends of the sliver has been before explained; the long end being that which was first drawn off from the comb, and contains the longest fibres of the wool; the short end is that which came last from the comb, and contains the short fibres. The wool-comber lays all the slivers of each ball the same way, and marks the long end of each by twisting up the end of the sliver. It is a curious circumstance, that when a top or ball of slivers is unrolled and stretched out straight, they will not separate from each other without tearing and breaking, if the separation is begun at the short ends, but if they are first parted at the long ends they will readily separate.

**Breaking-frame.**—Here the slivers are planked or spliced together, the long end of one to the short end of another; they are immediately drawn out and extended by the rollers of the breaking-frame. A sketch of this machine is given in Plate II, fig. 5; it consists of four pairs of rollers, A, B, C, D. The first pair A receives the wool from the inclined trough E, which is the planking-table. The slivers are unrolled, parted, and hung loosely over a pin, in reach of the attendant, who takes a sliver and lays it flat in the trough, and the end is presented to the rollers A, which being in motion...
motion will draw the wool in; the fliver is then conducted through the other rollers, as shown in the figure: when the fliver has passed half through, the end of another fliver is placed upon the middle of the first, and they pass through together; when this second is passed half through, the end of a third is applied upon the middle of it, and in this way the short flivers produced by the combing are joined into one regular and even fliver.

The lower roller C receives its motion from the mill, by means of a pulley upon the end of its axis, and an endless strap. The roller which is immediately over it is borne down by a heavy weight c, suspended from hooks, which pass over the pivots of the upper roller. The fourth pair of rollers D moves with the same velocity as C, being turned by means of a small wheel upon the end of the axis of the roller C, which turns a wheel of the same size upon the axis of the roller D, by means of an intermediate wheel d, which makes both rollers turn the same way round. The first and second pairs of rollers, A and B, move only one-third as quick as C and D, in order to draw out the fliver between B and C to three times the length it was when put on the planking-table. The flow motion of the rollers A is given by a large wheel a, fixed upon the axis of the roller A, and turned by the intermediate cog-wheels b, c, and d; the latter communicates between the rollers C and D. The pinions on the rollers C and D being only one-third the size of the wheel a, C and D turn three times as fast as A, for b, c, and d, are only intermediate wheels. The rollers B turn at the same rate as A. The upper roller c is loaded with a heavy weight, similar to the roller A; but the other rollers, B and D, are no farther loaded than the weight of the rollers.

The two pairs of rollers A B and C D are mounted in separate frames, and that frame which contains the third and fourth pairs, C D, slides upon the cast-iron frame F, which supports the machine, in order to increase or diminish the distance between the rollers B and C. There is a firewheel f, by which the frame of the rollers is moved, so as to adjust the machine according to the length of the fibre of the wool. The space between B and C should be rather more than the length of the fibres of the wool. The intermediate wheels b and c are supported upon pieces of iron, which are moveable on centres: the centre for the piece which supports the wheel b is concentric with the axis of the roller A; and the supporting piece for the wheel c is fitted on the centre of the wheel d. By moving these pieces, the intermediate wheels b and c can always be kept in contact, although the distance between the rollers is varied at times. By means of this breaking-frame, the perpetual fliver which is made up by planking the flivers together is equalized, and drawn out three times in length, and delivered into the can G.

Drawing-Frame.—Three of these cans are removed to the drawing-frame, which is similar to the breaking-frame, except that there is no planking-table E. There are five sets of rollers, all fixed upon one common frame F, the breaking-frame which we have described being the first. As fast as the fliver comes through one set of rollers, it is received into a can, and then three of these cans are put together, and passed again through another set of rollers. In the whole, the wool must pass through the breaker and four drawing-frames before the roving is begun. The draught being usually four times at each operation of drawing, and three times in the breaking, the whole will be $3 \times 4 \times 4 \times 4 = 768$; but to suit different sorts of wool, the three last drawing-frames are capable of making a greater draught, even to five times, by changing the pinions; accordingly the draught will be $3 \times 4 \times 5 \times 5 \times 5 = 1500$ times.

The size of the fliver is diminished by these repeated drawings, because only three flivers are put together, and are drawn out four times; so that in the whole, the fliver is reduced to a fourth or a ninth of its original bulk.

The breaking-frame and drawing-frame, which are used when the flivers are prepared by the combing-machines, are differently constructed; they have no planking-table, but receive three of the perpetual flivers of the combing-machine from as many tin cans, and draws them out from ten to twelve times. In this case, all the four rollers contribute to the operation of drawing: thus the second rollers B move $\frac{1}{2}$ times as fast as the rollers A; the third rollers C move 8 times as fast as A; and the fourth rollers E move $\frac{1}{3}$ times as fast as A. In this case, the motion is given to the different rollers by means of bevelled wheels, and a horizontal axis, which extends across the ends of all the four rollers, to communicate motion from one pair of rollers to another.

There are three of these systems of rollers, which are all mounted on the same frame; and the first one, through which the wool passes, is called the breaking-frame, but it does not differ from the others, which are called drawing-frames. The flivers which have passed through one system of rollers are collected four or five together, and put through the drawing-rollers. In all, the flivers pass through three drawings, and the whole extension is seldom less than 1000 times, and for some kinds of wool much greater.

After the drawing of the flivers is finished, a pound weight is taken, and measured by means of a cylinder, in order to ascertain if the drawing has been properly conducted; if the fliver does not prove of the length proposed, according to the size of worsted which is intended to be spun, the pinions of some of the drawing-frames are changed, to make the draught more or less, until it is found by experiment that one pound of the fliver measures the required length.

Roving-Frame.—This is provided with rollers the same as the drawing-frames: it takes in one or two flivers together, and draws them out four times. By this extension, the fliver becomes so small, that it would break with the slightest force, and it is therefore necessary to give some twist; this is done by a spindle and flyer. (See fig. 6.) A B are the two pairs of rollers, between which the fliver is passed; the first rollers A turn round slowly, but the others B revolve four times as quick, to draw the fliver to four times its original length; and as fast as it issues from the roller, it is twisted by the motion of the spindle C, and wound up upon the bobbin a. The spindle C is put in motion by a whip-cord band, which passes round the pulley e, and also round the wheel D. This wheel is fixed on a vertical axis e, which has a pinion on the upper end, to give motion to the lower roller B, by means of a bevelled wheel upon the end of its axis. The opposite end of the axis has also a bevelled pinion upon it, to give motion to a bevelled wheel fixed upon a horizontal axis, which carries another bevelled pinion, to give motion to a bevelled wheel fixed upon the end of the axis of the back rollers A. The sizes of these wheels and pinions are so proportioned, that the back rollers A turn only once to every four turns of the front rollers B, as before mentioned.

The back rollers are capable of being set at a greater or less distance from the front rollers, according to the length of the fibres of the wool, and in all cases the distance should be rather more than the length of the fibres, but not a great deal.

4 X 2
The spindle is supported on its point, and sustained by a collar at the middle of its length. Upon the top of the spindle, the flyer $f$ is fixed; it has two branches, which turn downward, and one of them has an eye at the lower end, through which the roving is conducted, in order to lay it upon the bobbin $a$. This bobbin is fitted loosely upon the upper part of the spindle, and rests with its weight upon a piece of wood projecting from the bobbin-rail $j$. The rail is made to rise and fall continually with a slow motion, so as to present every part of the bobbin in succession to the eye of the flyer, and thereby wind the roving upon every part of the length of the bobbin. The bobbin is not fixed upon the spindle, but is fitted loosely thereupon, and by resting upon the piece of wood which is fixed to the bobbin-rail, there is so much friction and resistance to the motion of the bobbin, that it gathers up the roving by winding it round itself as fast as the rollers give it out. The twist given to the roving is just enough to make it hang together, and one turn in each inch is usually enough. Some roving-frames are made with four pairs of rollers, and drawn ten or twelve times; and in this way, it is not necessary for the sliver to pass frequently through the drawing-frame.

**Spinning-Frame.**—This is so much like the roving-frame, that a short description will be sufficient. The spindles are more delicate, and there are three pairs of rollers instead of two; the bobbins which are taken off from the spindles of the roving-frame, when they are quite full, are stuck upon wires at L (fig. 7.), and the roving which proceeds from them is conducted between the rollers. The back pair $A$ turns round slowly; the middle pair turns about twice for once of the back rollers; and the front pair $B$ makes from twelve to seventeen turns for one turn of the back rollers $B$, according to the pinions which are employed, and these can be changed according to the degree of extenion which is required.

The spindles must revolve very quickly in the spinning-frame, in order to give the requisite degree of twist to the worsted. The hardest twisted worsted is called tammy-warp, and when the size of this worsted is such as to be twenty or twenty-four hanks to the pound weight, the twist is about ten turns in each inch of length. The leat twist is given to the worsted for fine bobbins, which from eight to twenty-four hanks to the pound. The twist is from five to six turns per inch. The degree of twist is regulated by the size of the whirrs or pulleys upon the spindle, and by the wheel-work, which communicates the motion to the front rollers from the band-wheel, which turns the spindles.

It is needless to enter more minutely into the description of the spinning machinery for worsted, because the construction is very similar to the water-frame for spinning cotton, invented by Sir Richard Arkwright, and which is fully described in our article Manufacture of Cotton. The differences between the two are chiefly in the distance between the rollers, which in the water-frame is capable of being increased or diminished at pleasure, according to the length of the fibres of the wool, and the draught or extent of the roving is far greater than in the cotton.

**Reeling.**—The bobbins of the spinning-frame are placed in a row upon wires before a long horizontal reel, and the threads from 20 bobbins are wound off together. The reel is exactly a yard in circumference, and when it has wound off 80 turns, it rings a bell; the motion of the reel is then stopped, and a thread is passed round the 80 turns or folds which each thread has made; the reeling is then continued till another 80 yards is wound off, which is also separated by interweaving the same thread; each of these separate parcels is called a ley, and when seven such leys are reeled, it is called a hank, which contains 560 yards. When this quantity is reeled off, the ends of the binding thread are tied together, to bind each hank fast, and one of the rails of the reel is struck to loosen the hanks, and they are drawn off at the end of the reel. These hanks are next hung upon a hook, and twisted up hard by a flick, then doubled, and the two parts twisted together, to form a farm bundle. In this state, the hanks are weighed by a small index-machine, which denotes what number of the hanks will weigh a pound, and they are sorted accordingly into different parcels. It is by this means that the number of the worsted is ascertained as the denomination for its finenesses: thus No. 24. means that 24 hanks, each containing 560 yards, will weigh a pound, and so on.

This denomination is different from that used for cotton, because the hank of cotton contains 840 yards instead of 560; but in some places, the worsted hank is made of the same length as the cotton.

To pack up the worsted for market, the proper number of hanks are collected to make a pound, according to the number which has been ascertained; these are weighed as a proof of the correctness of the sorting, then tied up in bundles of one pound each, and four of these bundles are again tied together. Then 60 such bundles are packed up in a sheaf, making a bale of 240 pounds, ready for market.

From this account of the processes of worsted spinning, it will be seen that they are very similar to those of cotton-spinning, after the first preparation of the wool by combing instead of carding.

**Worsted-Cord, in Sheep-Farming,** is a sort of cord which is sometimes used for tying round the necks of sheep affected with the fcab, after it has been well smeared over with the common mercurial ointment of the fries, in order to cure them of that disease. See Scab.

**WORT, in the Materia Medica,** is the sweet infusion of malt; first prepared by Dr. Macbride as a dietetic article to scrobutic persons, from an apprehension that it would ferment in their bowels, and give out its fixed air, by the antifeptic powers of which the strong tendency to putrefaction in this disease might be corrected. It was some time before a fair trial of this proposed remedy could be obtained, and different reports were made concerning it. In 1762, the lords of the admiralty gave orders to have the wort tried in the naval hospitals at Portsmouth and Plymouth; but the murmurs of the patients, on account of restrictions that were necessary for determining its efficacy, put a stop to the farther exhibition of it; and indeed Dr. Huxham, in 1764, informed the ingenious and benevolent proposer of this remedy, that it had been tried with very bad effects. But Dr. Macbride assures us, on the testimony of a gentleman who made use of the wort, that it may be taken for a length of time, to the quantity of a quart in the day, without producing any ill effect whatever; and he refers to Van Swieten's Commentary, vol. iv. p. 673, where we learn, that the baron's lady, when a nurse, used regularly to drink a pint of it every night going to bed, in order to increase her milk.

After the failure of success in the naval hospitals, orders were issued to have the wort administered on ship-board, where no temptations of fresh vegetables would offer to make the men uneasy. But a considerable time elapsed, before any reports were made either of its good or bad effects. Dr. Macbride, however, persisted in recommending
WORT.

ing it, and lived to publish several essays, in a postscript to the second edition of his work, in 1767, from which it appears, that are uterative complaints of the most dangerous kind have actually been cured at sea by the use of wort. Its general effects were, to keep the patients open, and to prove highly nutritious and strengthening; it sometimes purged too much; but this effect was easily obviated by the tinctura thebaica. Other unquestionable cures of its successes in this disease are to be seen in the London Med. Obs. and Inq. vol. v. p. 61. See also Scurvy.

The use of wort has hence been adopted in other cafes, where a strong putrid diffipation in the fluids appeared to prevail, as in cancers and phlegmonic ulcers; and instances are published of its remarkable good effects in these cafes. See London Med. Obs. and Inq. vol. iv. p. 367, &c.Priestley on Air, vol. 3. Appendix.

As the efficacy of the malt infusion depends upon its producing changes in the whole mass of fluids, it is obvious that it must be taken in large quantities for a considerable length of time, and rather as an article of diet than medicine. The quantity of one to four pints has generally been directed. See Scurvy.

WORT. Improved Machine for flirring Malt in making of
in Rural Economy, a contrivance for this purpose in brewing and distilling, fitted to vats of this sort, which are employed in forming the wort or wath. There are many modes of flirring malt in the vats or tubs for malting in, employed in different places and instances; but they are in most cafes either expensive, or inadequate to the purposes as well as the powers which are made use of in the work. Among the former may be ranked the admirably well-conceived machine that is in use by Jellet and Co. at Dollhill, in Somersettshire, which is on a planitary system, and answers the intention very effectually; but its great cost renders it liable to objection in many cafes. The well-known contrivance of a male screw flirring upright in the centre of the vat, on which a bar works by means of a female screw operating on the male standard one, and thus causing the spikes with which the different wings of the bar are armed to flir the malt as the spiral motion proceeds, is certainly simple, neat, and cheap; but as it requires two men, one at each end, and makes but little change of locality among the malt-grain, much cannot be urged in favour of its efficiency for this use. The instrument known by the name of the hedge-bog, which is in use in some breweries, is a dreadful-looking machine, that would seem intended to divide some very tough or viscous substanee rather than to flirr malt in this intention. It consists of a roller about two feet in diameter, and six or seven in length, made of iron skeleton work; the longitudinal bars are bound with rings or hoops, furnished with spiky rims, to keep in due bounds a sort of chain-work, armed also with spikes, which chains revolve upon the rings as the frame rolls round, urged by the powers of horsetails, and thus not only tears the maltage through the contents of the malting-vat, but keeps raising them up, carrying giving a considerable portion of the spiky chain quite over the wheel, and exposing the malt perpetually to the influence and action of the air; a practice invariably disapproved of by all good brewers. In this cafe, there are expense, labour, friction, &c. all crowded into one form, without any material advantage.

A plan has, however, been lately suggested for flirring malt while in the malting-vat by a machine or contrivance wrought by the power of horses, or in other ways, which is nearly without friction, and diverts of the intervention of any secondary action that may be troublesome or expensive. It is very simple; and one vat of this sort may be flirred by a very trifling power; but as in large breweries and distilleries from malt a number of mashing vats are mostly requisite, which generally require to be flirred in succession, an arrangement is given for facilitating and bringing the operations of five vats, one in the middle and four around it, into a narrow or small compass, and under the action of one power; which not only affords much convenience, but occasions the expense and the labour to be greatly lessened; consequently it may be useful in large as well as small establishments of this nature.

In this plan, the centrical circular vats for this purpose is raised sufficiently to admit the necessary gear and other matters for a horse-walk underneath it. The upright axle passes through the floor, and through the centre of the vat, proceeding up to a beam in which it moves in a metal bush, as it does also below, where it rests on a step. It does not, however, touch either the floor or the vat; but at the distance of a few inches it is surrounded by a cylinder, forming part of the vat, which prevents its contents from passing through the aperture in the floor. This cylinder corresponds in height with the external edge of the vat, and is firmly closed at the bottom, where, as well as at the outer part, it is rounded off, so as to be the more easily drained and cleaned.

As it is requisite at times to move the malt in the other vats, while the central one is at rest, there arises a necessity for constructing the wings of the flirring-frame in the latter in such a manner as may liberate them, leaving them inactive, while the axle proceeds in its ordinary revolutions.

The flirring-frame is made of iron; it has four wings flirring at right angles, and they all join to an iron collar which surrounds the axle at some distance, that is, leaving about an inch intermediate all around. When the flirring-frame is to move with the axle, it is fastened to it by two iron pins, with long handles, so as to enable the workmen to affix them in their proper sockets, without going into the vat. These pins pass through the collar into the axle, thereby causing the flirring-frame to move round in the vat, as the axle is moved round by the horse, or other power.

As the flirring-frame in the centre vat cannot be connected all the way down its depth with the axle, on account of the cylinder, and as it would be liable to swing, if depending entirely on its junction with the collar, oblique stays are indispensable; they are carried out about two-thirds of the length of the frame, where they are riveted: their upper ends are secured to another collar, surrounding the axle above.

Each wing of the frame consists of two iron bars, one at the top, and one at the bottom; between the bars are three fixed uprights made of thin sheet-iron, and flirring at angles of forty-five degrees, and they are fastened above and below into the horizontal iron bars, so as to be perfectly strong and steady in their positions. The valves do not, however; all stand the fame way: the internal ones are all point inwards, the outward ones all point outwards, and the middle ones alternately inwards and outwards.

Thus far wholly relates to the centrical vat, which may be surrounded by four others of less capacity, in which there will be found the differences noticed below: 1. That the bottoms not being perforated no cylinders are required. 2. That the axles for their respective frames rest on steps at their bottoms, in which iron gudgeons move in iron bushes. 3. That the frames all connect with the axles for the whole of their depth. And 4. That no stays or collars are wanted in them.

On
On the main axle are four drums of about one-fourth the diameter of the centre vat; they are each about one foot in thickness, and deeply grooved all around, like the sheave of a pulley, for the purpose of receiving a band. An interval of about six inches is left between them, in the intention of receiving the band respectively, so that the corresponding drums on the axes in the other vats may be left at rest whenever those vats are not at work. Thus the four drums which are firmly fixed to the main axe, and revolve with it, turn the four drums fixed to the axes in the four vats respectively. But as the four drums on the main axe are all of different heights from the surface of the vat, the several drums on the axes in the other vats must be respectively of corresponding heights with those that act upon them on the main axe. An idea of the manner in which the bands extend to the four vats may be formed by observing that in order to produce greater contrivance, and consequently greater power, they all form a figure of 8 in their progress; thereby occasioning the four surrounding vats to be stirred by a counter motion; that is, the frames will revolve the opposite way to that in the centrical vat. The drum on each of the latter vats should, however, be of the same size as that on the central axis from which it receives its motion, whereby the whole will move at the same rate, and the malt be equally stirred.

The intervals between the different vats will allow ample access to the works, and admit bcsides of standards, &c. for the support of the flooring above; there being no part of the machinery that in the least interferes with those spaces; and the bands being completely out of the passageway of all work, they can be easily shifted off and on to the central drum by means of a pole with an iron at its end, formed so as to embrace and direct them into the grooves.

On the whole it is supposed, that the plan here laid down may be safely affeeted to be cheap, simple, and effectual; and that it would not probably be easy to find any machinery for this use less complex, and in which the power is so immediately applicable to the object. For though it might be objectionable in work requiring perfect regularity, and an unvaried equable motion, without which the operations would be ill performed, and the machinery itself be liable to great injury, and to be perpetually out of order, yet in the business of merely stirring the malt in a Mash-vat in the making of wort or waf, inequality of motion can never produce any bad effect.

The driving power in these cafes should move rather slowly, and when of the animal kind, it may be increased without the addition of more strength, merely by extending the length of the lever, and causing the animal by such means to describe a larger circle; but which may not, however, be always convenient for want of perpendicular support for the flooring above. On most occasions, the Mash-vats in making wort or waf may, however, be computed not to exceed twelve feet in diameter, in which cafes the horse-walks need not be more than twenty feet over, equal to about twenty yards in circumference; and in this case, supposing the horse to move at the rate of two miles in the hour, he would go round eighty-eight times in the course of that time, and cause the malt to be stirred nearly three times in the space of every two minutes; but if the lever were longer, the motion within the vats would be flower in proportion.

WORTH, in Geography, a town of Bavaria; 12 miles E. of Ratibon.—Allo, a town of the principality of Hesse Darmfladt; 20 miles E.S.E. of Darmfladt.

WORTH Barrow Bay, a bay of the English Channel, on the south coast of the county of Dorset; 11 miles E. of Weymouth.

WORSTHEST of Blood, in Law, an expression denoting the preference given in defects to sons before daughters.

WORTHING, in Geography, a fashionable and much-frequented watering-place in the parish of Broadwater, and county of Suffolk, England, is situated on the sea-coast, 11 miles W. from Brightlingstone, 9 1/2 E.S.E. from Arundel, and 58 S. by W. from London. Formerly an obscure fishing-village, Worthing is much indebted for its present improvement to its situation on a very extensive stretch of fine level sandy beach, particularly convenient for bathing, and to the range of chalk-hills behind it called the South Downs, affording at once shelter to the town and lands, and space for exercise to the invalid. The town extends northward from the shore, but some new buildings are situated near the beach, and are adapted to the reception of families of the first rank. The Steyne, a range of handsome houses, and the parallel row called Warwick-buildings, form the E. and W. sides of a square, open to the sea on the S. and to the Downs on the N. A quarter of a mile from the beach is a neat chapel, erected by subscription in 1812. Worthing has a theatre, libraries, bathing-machines, and warm baths, and is thus amply provided for the use and amusement of visitors. Warwick-houe is not only the most distinguished mansion in Worthing, but for its extent and appearance entitled to a high rank among the noble mansions of the kingdom. It was erected by the earl of Warwick, while proprietor of the manor of Broadwater; but no longer belonging to that family, it is usually occupied by some person of distinction in the bathing-season. Broadwater village is half a mile from Worthing; it was the chief place of the barony of Canoi, in the time of Edward I. The parish also comprehends Offington, the ancient but now much-altered seat of the lords de la Warr. The church of Broadwater is constructed on the cathedral plan, with a mixture of the circular and early-pointed styles of architecture. The population of Worthing fluctuates according to the season of the year; but that of the whole parish of Broadwater, in 1811, was 2692 persons, and the houses were 629. — Beauties of England and Wales, Suffex; By F. Shoebler, 8vo. London, 1813.

WORTHINGTON, a port-town of Massachusetts, in the county of Hampshire, containing 1391 inhabitants; 19 miles N.W. of Northampton.

WORTLEY, a township in the parish of Tankerley, and county of York, England. According to the population report of 1811, it contained 173 houses, and 925 inhabitants, most of whom were employed in agriculture.

WORTON CREEK, a river of Maryland, which runs into the Chesapeake, N. lat. 39° 20', W. long. 76° 16'.

WORTOWA, a town of Bohemia, in the circle of Chrudim; 14 miles S. of Chrudim.

WORUMBANG, a town of Africa, in Mandingo. N. lat. 12° 40', W. long. 6° 55'.

WOSCHICK, or Woznicky, a town of Silecia, in the principality of Oppeln; 14 miles N.N.E. of Bethen.

WOSITZ, a town of Pomerelia; 10 miles S.E. of Danzig.

WOSSBERK. See Weissenberg.

WOSTERZEDECK, a town of Bohemia, in the circle of Kaurzim; 12 miles S.W. of Kaurzim.

WOSTOCK, a town of Brandenburg, in the Middle Mark; 11 miles S.S.E. of Berlin.

WOSTROW, a town of Bohemia, in the circle of Czaflau; 12 miles S.W. of Czaflau.

WOTCHAT,
WOTCHAT, in Agriculture and Rural Economy, a term provincially applied in some districts to an orchard.

WOTRALLY, in Geography, a town of Hindoofian, in Myfore; 8 miles N. of Allumbuddy.

WOTROW. See OSTRITZ.

WOTTON, Sir Henry, in Biography, was born at Boughton-hall, in Kent, in 1568, and in 1584 entered of New college, Oxford, from which he removed to Queen's college. During his residence in the university, he applied with diligence to the study of logic and philosophy, of polite literature and civil law, and at this time composed a tragedy, which gained the applause of his fellow-collegians. Upon the death of his father in 1589, he availed himself of the small patrimony that was left to him in travelling through France, Italy, Germany, and the Low Countries, in order to improve his acquaintance with men and manners in these several countries. On his return in 1596, he was appointed secretary to the earl of Essex; and when this nobleman was apprehended on a charge of high treason, he consulted his own safety by quitting the kingdom. As he fixed his residence chiefly at Florence, he employed himself in composing a treatise, which was published after his death in 1657, under the title of "The State of Christendom; or, a most exact and curious Discovery of many secret Passages and hidden Mysteries of the Times." When a plot was detected by the grand-duke of Tufcany for taking away the life of James, king of Scotland, Wotton was engaged to communicate intelligence of it to the king. Having fulfilled this mission, he returned to Florence; and when James came to the crown, he recomposed his service by conferring upon him the honour of knighthood. In 1604 he was appointed ambassadress in ordinary to Venice, where he acquired such reputation that several young gentlemen of rank attended him for improvement. In his way through Augsburg, he drew up the following humorous definition of an ambassadress:—"Legatus eft vir bonus peregre minus ad mentandum reipublica causa," i.e., an ambassadress is a good man, sent abroad to lie for the service of his country. This sentence was afterwards alleged as a maxim avowed by the religion professed by the king of England; and it so far excited the displeasure of James, that Wotton, after his return, remained for five years unemployed. An apology, however, regained the royal favour, and he was sent on an embassy first to the United Provinces, and afterwards in 1615 to Venice. After three years' residence he returned with the hope of succeeding to the office of secretary Winwood, but he was otherwise employed in various foreign embassies, from the lafl of which to Venice he did not return till after the death of James, when he was appointed, as a recom mission for his services, to the provostship of Eton college in 1624. Soon after his settlement in this situation, he published his "Elements of Architecture." But as the statutes of the college required his assuming the clerical character, he took deacon's orders, without undertaking what he considered as too serious a charge, the cure of souls. In his domestic entertainments he maintained the reputation of hospitality, and in his connection with the feminary over which he presided, he was a liberal encourager of genius and application. For the amenuen of advanced life he had contemplated a life of Luther, with the history of the Reformation; but Charles I. persuaded him to undertake a history of England, in which, however, he made little progress. Having large demands on government for money advanced in foreign services, his circumstances were embarrassed, and he frequently solicited his majesty to grant him new preferment. But death was the only termination of his wants and wishes; and this happened in December 1639, in the 72d year of his age. His remains were interred in the chapel of Eton college, and the following epitaph was inscribed on the stone that covered them by his own order:—"Hic jacet hujus fententiai primus author, Difputandi Pruritus Ecclesiarum Stabiles. Nomen alias quare." His accomplishments and literary acquisitions were very distinguislied; and they are hyperbolically stated in Cowley's elegy, when he speaks of him as one

"Who had so many languages in store, That only fame shall speak of him in more."

But Wotton occupied so much of his time, that he had little leisure for writing. After his death were published his "Reliquiae Wottonianae," and they have often been reprinted. Of his poems, there is one entitled "A Hymn to my God in a Night of my late Sickness," which has been highly extolled. "Biog. Brit."

WOTTON, William, a learned clergyman, was born in 1666, and under the tuition of his father, was also a clergyman, he became a perfect phenomenon as to the knowledge of languages; for at the age of five years he could read the Latin, Greek, and Hebrew languages almost as well as English. Accordingly he was entered of Catharine-hall, Cambridge, some months before he was ten years of age: at twelve years and five months he took the degree of B.A., some time before which he had been celebrated in a copy of verses by Dr. Duport, not only for his acquaintance with the learned languages, including Arabic, Syriac, and Chaldee, but his knowledge of geography, logic, philosophy, mathematics, and chronology. He commenced B.D. in 1691, and being chaplain to the earl of Nottingham, this nobleman presented him in 1693 to the rectory of Middleton-Keynes, in Buckinghamshire. His first work appeared in 1694, and was entitled "Reflections upon Ancient and Modern Learning." A second edition was published in 1697, and to this was annexed Dr. Bentley's Dif- ference upon Phalaris, which involved Wotton in controversy, and subjected him to the sarcasm of Swift's Battle of Books. Wotton defended his own book against the objections of Sir W. Temple and others, and some observations in the Tale of a Tub, in the third edition in 1705. In 1701 he published "The History of Rome, from the Death of Antoninus Pius to the Death of Severus Alexander," 8vo, undertaken at the requell of bishop Burnet, for the use of his pupil the duke of Gloucester; and recommended by Leibnitz to George II. when Elector Prince. In 1706 he attacked "Tindal's Rights of the Christian Church," and in 1707 archbishop Tenison conferred upon him the degree of D.D. Notwithstanding his talents and learning, his life was irregular, and of course his circumstances embarrassed, so that in 1714 he was obliged to retire into South Wales, where he employed himself in writing. He also acquired the Welsh language, and was able to preach in it. Dr. Wotton, says one of his biographers, was one of those scholars, whose early proficiency, being chiefly the result of an extraordinary memory, was not followed by mature products corresponding to the expectations they excited. He died at the age of 60, in the year 1726. "Nichols's Lit. Anecd. Gen. Biog."

WOTTON-under-EDGE, in Geography, a large and populous market-town in the upper division of the hundred of Berkeley, Gloucestershire, England, is situated at the base of a ridge of woody hills (whence its name is evidently derived), at the distance of 19 miles S.S.W. from Gloucester, and 188 miles W. by S. from London. It is a borough by prescription, though it sends no members to parliament. In the
the reign of king John it was nearly destroyed by fire, and
a place called the Brands is supposed to mark its ancient
site. The present town consists of several streets, and
stands on nearly sixty acres of ground; the buildings in
general are good, and some, belonging to families of pro-
erty, are modern and elegant. The government of the
town is vested in a mayor and twelve aldermen. In the year
1527, Maurice, lord Berkeley, an ancestor of the present
earl of Berkeley, who now holds the manor, obtained a grant
of a weekly market on Fridays, and an annual fair, both of
which are still held. The church is a spacious, handsome
fabric, and contains numerous monuments and sepulchral
memorials. Here is a free-school, erected in 1585, by Ca-
terine, elict of Thomas, lord Berkeley: also an alms-house
for six poor men and six poor women, built and endowed in 1632,
by Hugh Perry, alderman of London, at the charge of
1000l. A like sum was given by sir Jonathan Dawes, sheriff
of London, for the relief of the poor. In the population
return of the year 1811, the houses in this town were
certained as 217, the inhabitants as 1527; the latter are
chiefly employed in the clothing manufacture, which is
chiefly carried on to a considerable extent in the town and its
vicinity: one factory only, called New Mill, employs under
its roof about 200 men, women, and children. Spanish
wool alone is manufactured at this place, and is employed
for the weaving of broad-cloth and kerseymere.—Rudge's
History of Gloucestershire, 2 vols. 8vo. 1803. Beauties of
England and Wales, vol. v. Gloucestershire, by J. Britton
and E. W. Brayley, 1844.

WOTYCHOW, a town of Poland, in the palatinate
of Lublin; 12 miles W.S.W. of Lublin.

WOTZLERSDORF, a town of Austria; 10 miles
W. of Zittdorff.

WOUDRICHEN. See WORCM.

WOVEN STOCKINGS. See STOKING.

WOUGHS, in Mines, are the walls or sides sometimes
of hard flones, and sometimes soft; when soft, the miners
say they are rotten; these are the bounds of an entry. Be-
twixt them all sorts of earth, flones, and ore lie; or, as
philosophers say, grow.

WOULD, or WELD, among Dyers. See WELD, and
DYR'S. See WOOD, and
DYR'S. See WOOD.

WOULD, in Agriculture, a term applied in some cases to
signify an open uninclosed tract of country.

WOULD LAND, that which remains in the state and condi-
tion of would. There is much of this sort of land in
many counties and districts of this country which might be
still greatly improved and converted to far better purpo-
tures than at present, by simply inclining them and turning them
into a state of proper and suitable cultivation. This has
been already done with large tracts in Yorkshire and Glou-
cestershire to very great benefit, and the fame may be the
case with many others in different places. See WASTE
LAND.

WOULDS, a term applied by some writers on husbandry
to crops of the wood kind. See WOAD.

WOOLDING. See WOOLING.

WOULMARA, in Geography, a town of Bengal; 28
miles S. of Midnapour.

WOUNDS, in Surgery, constitute the most ancient
and important branch of it, accidental injuries of this kind having
in all probability preceded the existence of many of the dis-
eases to which mankind are now liable. The turbulent and
enterprising spirit of the earliest generations soon produced
wars, and the effusion of human blood; and even the natural
habits of every people, in a state of inferior civilization,
would conduce to the receipt of wounds, since the chase,
WOUNDS.

Thus the stings and bites of a variety of insects afford us examples of poisoned wounds; but a more serious and dangerous influence, which we meet with in this climate, is seen in the cuts accidentally received in the dissection of putrid bodies, or in handling instruments infected with any irritating venemous matter; as sometimes happens to the surgeon in the performance of operations on gangrenous limbs, and in the application of dressings to venereal and other infectious ulcers. The most dangerous, however, of all the poisoned wounds, which ever occur in this kingdom, are those resulting from the bite of the viper, and from the bites of rabid animals, particularly the dog and cat. See HYDROPHobia.

Wounds are farther divided by surgical writers into wounds of the head, wounds of the face, wounds of the throat, wounds of the chest or thorax, wounds of the belly or abdomen, wounds of the limbs or extremities, wounds of the arteries, wounds of the skin, &c., &c.

Wounds may likewise be universally referred to two other general classes, viz. simple and complicated. A wound is called simple, when it occurs in a healthy subject; it has been produced by a clean, sharp-edged instrument; it is unattended with any serious symptoms; and the only indication is to introduce the fresh-cut surfaces. A wound, on the contrary, is said to be complicated, whenever the site of the wound, or of the wounded part, or wound itself, is such as to make it necessary for the surgeon to devise the plan of treatment requisite for a common simple wound. The differences of complicated wounds must, therefore, be very numerous, as they depend upon many incidental circumstances, the principal of which, however, are, hemorrhage, nervous symptoms, contusion, the unfavourable shape of the injury, the discharge or extravasation of certain fluids indicating the injury of particular bowels or vesels, the presence of foreign bodies or a virus in the part, loss of substance, the attack of hospital gangrene, &c. See ULCER.

All large or deep wounds are attended with more or less symptomatic fever. It usually comes on, as Dr. Thomson observes, at a period varying from sixteen to thirty-six hours after the infliction of the injury. Its occurrence is indicated by an increased warmth of the skin; by increase in the frequency, and generally also in the strength of the action of the heart and arteries; by anxiety, thirst, and by the suppression of the powers of digestion. The symptomatic fever from wounds is generally of the inflammatory character; and it even sometimes happens that a very high degree of symptomatic fever occurs in debilitated constitutions, and in persons who have lost a considerable quantity of blood. In these cases, the frequency of the pulse, however, is more remarkable than its strength, and the fever which occurs seems to resemble more an asthenic fever than it does one that is truly inflammatory. It is of great consequence to attend to the type of this fever in the treatment; for the loss of blood, which may be required and sustained with impunity in the one species of fever, may prove most injurious, if not fatal, in the other. Thomson’s Lectures, &c. p. 292.

We shall now proceed to offer a general description of the several kinds of wounds, and the manner of treating them; and then notice the wounds of particular parts, and the surgical measures which seem best calculated to promote their cure. As, however, wounds of the head, comprehending its external coverings, and the cranium and brain, form the subjects of articles already published, these cases will not fall under consideration in the subsequent columns, the reader being referred for information concerning them to Compression.
Compression, Concussion, Extravasation, Head, Injury of, and Trepanning.

Of Cuts or incised Wounds.—Sharp-edged instruments may produce a division of the parts upon which they act, altogether on the principle of direct pressure; in which case, they may be regarded as operating in the manner of a wedge. In other instances, they both press and saw at the same time, and then the solution of continuity is made with more facility, and carried to a greater depth, because the fibres are elongated in the direction in which the instrument favors, as well as in that in which it presses.

In whatever way a cutting instrument operates, several consequences result from the division of the parts. 1st, An effusion of blood from the divided vessels. 2dly, Pain, arising from the division of nerves. 3dly, A gaping of the wound, or separation of its edges from each other.

Anatomy teaches us, that almost every part of the body is furnished with a considerable number of blood-vessels, which indeed exist in such myriads, that it is impossible to prick the skin with the point of the most minute needle, without opening one or more ramifications of vessels containing blood. But this effect always happens in a still greater and more remarkable degree, when the division, caused by a sharp-edged instrument, is at all extensive.

If the wounded vessels are of small size, the blood issues from them only in moderate quantity; but when they are large, the hemorrhage is more copious, and it may be so rapid as to prove almost instantly fatal. Many of the phenomena of hemorrhage have been already considered in another place (see Hemorrhage); and, on this account, we shall not have occasion now to travel over the whole of that interesting topic again. There are, however, certain parts of the subject which must fall under consideration in the course of this article; and, in mentioning them, we shall take the opportunity of noticing a few ingenious speculations, which have been made since the period when the above-mentioned article was written, and which, when further investigated, may lead to very important improvements in the treatment of wounds.

It has been stated, that hemorrhage is one of the circumstances which render wounds complicated; yet it is to be understood, that when the bleeding is not so considerable as to hinder the union of the parts, and a further effusion of blood can be prevented by the very same pressure which is necessary to promote this union, the case is always regarded as a simple wound. Such is that which is produced by the operation for the harelip, &c.

The same experiment which demonstrates the presence of blood-vessels in every situation, namely, pricking any part of the body with a needle, proves also that filaments of the nerves are found everywhere, and at every point; for the slightest prick of the skin occasions pain, and pain cannot happen except where there are nerves. But wounds are observed to be attended with pain, which is more or less acute, according to the kind of cutting instrument with which they are inflicted, the extent of the division, and especially according as the wounded person happens or not to be in expectation of the receipt of the injury. A patient, on whom an operation is to be performed, turns his whole attention to the effect which the use of the knife will produce upon his feelings, and he suffers a great deal; but if an incision be made when not expected, or a soldier be wounded in the heat of battle, the injury is sometimes not perceived till the bleeding attracts notice.

Immediately a part is divided with a cutting instrument, the edges of the wound separate more or less distantly from each other, and the injury presents a gaping appearance. This is an occurrence which is owing to several causes, necessary to be understood by every surgeon who is desirous of knowing the best mode of obviating it.

The first cause of the separation of the lips of a wound from each other is, no doubt, the thickness of the instrument with which the solution of continuity is made. A cutting instrument, acting like a wedge, must unavoidably separate the parts between which it enters; but if this were the only cause, the gaping of a wound would be very inconceivable, since the blades of most cutting weapons are extremely thin. We find, however, that the opposite surfaces of many wounds are drawn away from each other several inches, and the causes to which the phenomenon is to be ascribed are the elasticity and contractile nature of the divided parts; sometimes one of these properties operating singly, sometimes both of them together in the same wound.

Elasticity is a quality which belongs to all animal substances, and it is inherent in them even after they have been deprived of life; but it does not prevail in an equal degree in every texture. Thus, the gaping of a wound depending upon this cause varies very considerably, according to the nature of the divided parts. The edges of an incision made in the skin become widely drawn asunder, because the integuments are endowed with great elasticity. The cellular membrane, when cut, gapes very little, because it is less elastic. The muscles also are not remarkably elastic; yet wounds of them, especially transverse wounds, always have their opposite sides separated a vast distance from each other; but this is a circumstance which is owing not altogether to the elasticity of the parts, but partly to their contractile powers.

The separation of the edges of a wound is not always in proportion to the elasticity of the wounded part; it is likewise proportioned to the tension of this part at the very moment of the injury. An exceedingly simple experiment proves the truth of this observation; if the skin which covers the knee be divided transversely in the dead subject, while the leg is bent upon the thigh, and another similar incision be made in the other knee, while the leg is extended, the separation which happens between the edges of the division will be found to be much greater in the first than in the second example.

The contractile power, or irritability, which is a peculiar property of muscular fibres, and by virtue of which they tend continually to shorten themselves, is the most powerful cause of the separation which occurs between the opposite sides of a transverse wound of any muscle. The separation thus produced is greater in proportion as the cut muscular fibres are longer, inasmuch as the contraction of which the muscles are capable, by reason of their contractile power, is itself in a ratio to the length of the muscular fibres. Thus, as Boyer observes, if two muscles be divided transversely, the fibres of one of which are three times as long as those of the other, the separation which takes place between the edges of the wound of the former will be three times as great as what follows, between the sides of the division made in the latter.

The force with which the separation is produced by the contractile power of the muscles, is not in proportion to the length of the muscular fibres, but to their quantity. Each muscular fibre, being regarded as a separate distinct power, it is obvious, that the more these powers are multiplied, the greater must be the effect resulting from their action.

It appears also, that in addition to the first contraction of a divided muscle, a secondary and increased contraction of the part may be excited, when it is exposed and irritated.
From what has been stated, it seems then, that in wounds of parts destitute of contractile properties, as the skin, cellular membrane, ligaments, fascia, &c., their elasticity is the only cause of such wounds gaping, or of the separation which happens between the opposite surfaces of the injury; but that in muscular wounds the separation is the effect both of the contractile and elastic powers of the part. Hence, as we have already observed, the separation is greater the more tense the muscle is at the instant when the wound is inflicted.

"The edges of every incised wound (says professor Thomson) are more or less retracted, or drawn from each other, and this generally in proportion to the size of the wound, and the nature of the parts upon which it is inflicted. The different soft textures of which the human body is composed are more or less elastic, and are in the healthy condition of the body kept in a certain degree of tension. When the fibres, therefore, of any of these textures are divided, they recede from each other; those of skin farther than those of cellular membrane, and those of muscle farther than those of skin. The fibres of muscle contract most of all. The extremities of a divided artery recede considerably from each other; the veins less than the arteries, and the nerves probably less than the veins. To oppose this contraction of divided parts by suitable means, is one of the main objects which the surgeon proposes to himself in the cure of wounds; for the retraction of the edges of wounds from each other always prevents re-union by the first intention, and very often retards it for a long time by the second." See Thomson's Lectures on Inflammation, p. 280; also Union by the First Intention.

The prognosis of wounds made with a cutting instrument varies according to the extent and depth of the division, the nature of the injured parts, and the circumstances which attend the accident. Deep large wounds are more dangerous and more difficult to cure than those which only interfect the skin. Wounds, accompanied with injury of considerable vessels or nerves, are more or less dangerous, according to the magnitude or number of those vessels or nerves. Simple wounds, in which the only indication is to bring the divided parts together, so that they may re-unite, are the most favourable cases of all. On the other hand, complicated wounds are more or less hazardous, according to the particular nature of the complication. In the prognosis of wounds also, we must not forget to take into consideration the patient's age, his kind of constitution, and the diseases under which he may labour. Generally speaking, the most dangerous examples of incised wounds are those which are made about the throat by persons who attempt to destroy themselves. Here there are so many large blood-vessels, nerves, and other parts of great importance, that deep incised wounds too often prove fatal, either immediately, or in the course of a few days. Sometimes the patient opens the carotid artery, and periurles of hemorrhage on the spot, before any antiseptic can be rendered. In other instances, he divides some of the principal branches of the external carotid, and after losing a great deal of blood he faints, and the hemorrhage spontaneously ceases for a time. The fainting indeed is often the very thing which saves his life, by checking the effusion of blood until a surgeon arrives; who ties the vessels as soon as they begin to bleed again. Cut wounds of the extremities, when such arteries as the femoral and brachial are injured, may also suddenly destroy the patient, by the great quantity of blood which is sometimes lost before the arrival of surgical assistance.

A surgeon, called to a recent cut or incised wound, has three objects which he should endeavour to accomplish without the least delay.

The first, and that which requires his immediate interference, is the bleeding, which must be checked, or the patient may lose his life in a few minutes. The second is the removal of all extraneous matter, foreign bodies, &c. from the cavity of the wound.

The third is to bring the opposite surfaces of the wound into even contact, and to adopt proper measures for keeping them in this position, until they have grown together again.

1. Hemorrhage.—For an explanation of the means which nature employs in the suppression of bleeding from divided arteries, as well as for an account of the best surgical measures for promoting this object, and a detail of numerous observations on the principles by which the conduct of the surgeon should be regulated in the use of the ligature, we beg to refer to the articles Hemorrhage and Ligature.

In the present place we shall briefly notice how the surgeon ought to act in cases of incised wounds, accompanied with hemorrhage, without palping over, however, a few things which have been suggested since the above-mentioned articles were written.

It has been stated that in every wound the bleeding is the thing which demands the earliest attention; because if lots of blood be not prevented without delay, the patient will frequently die in the course of a few seconds, or minutes. Every other consideration may be deferred; but when large vessels are incurred, they must be immediately secured, or else the sudden death of the patient will leave the surgeon no opportunity of exhibiting his skill and usefulness in other matters connected with the treatment.

It is not, however, every bleeding which is thus serious and alarming; for the slightest and most superficial cuts are always attended with some effusion of blood. When the divided vessels are of inferior size, the bleeding soon spontaneously ceases, and no surgical measures need be taken on this particular account. When the wounded vessels are even somewhat larger, and their situation is favourable for compression with a bandage, it is often advisable to close the wound, and apply a compress and roller, instead of having recourse to ligatures, which always produce irritation, suppuration, and an obstacle to the union of that part of the wound in which they lie. Yet, let the surgeon, before he determines to truuf to pressure, be well assured, that the bleeding can be thus perfectly and safely commanded without the employment of ligatures; for by the failure of compression, hemorrhage has often been renewed from time to time, and many a life been lost. We therefore wish it to be distinctly understood, that in almost all cases of considerable bleeding, the patient will not be safe unless the vessels be tied, and that the only exceptions are a few in which the bleeding arteries can be effectedly compressed against a subjacent bone, and are not of very large size. In all other examples, tying the bleeding vessels is the only safe mode of proceeding. When the artery is of large diameter, and its mouth can be readily fed, the most proper instrument for taking hold of it is a pair of arterial forceps. With this instrument, the end of the vessel is to be drawn out a little way from the surrounding flesh, in order that a ligature may be put round it without the inclusion of any other parts, which would be uneccesary, painful, and on several accounts disadvantageous. In applying the ligature, the surgeon must take care to pull its two ends in such a manner that the noose will not ride above the mouth of the vessel; and, for the purpose of altering the direction of the
force employed in drawing the ligature, the ends of the thumbs are found most convenient. When the bleeding arteries are not very large and distinct, they are generally taken up with a tenaculum; and of late years a double tenaculum, the points of which that together, like the blades of a pair of forceps, has been occasionally used, and we have heard some well-informed surgeons speak highly of the invention, which we believe was originally made by professor Alflini, an ingenious surgeon at Milan, in Italy.

The ligatures having been applied, one end of each is to be cut off close to the knot, in order to diminish the quantity of extraneous matter in the wound.

When a large artery, like the brachial or femoral, is opened, but not cut through, it often happens that the surgeon cannot get at it without making a dilatation of the wound, and bringing the wounded part of the vessel more fairly into view. In cases of this description, the first duty of the practitioner is to compress the artery above the wound, and apply a tourniquet. Thus he will put an immediate stop to the bleeding; but if he omit this essential step, the vessel will continue to bleed so profusely and rapidly, that in the inevitable obscurity and confusion thence resulting, the patient may actually lose his life before the vessel is secured. When, however, a tourniquet has been applied, the surgeon can examine the wound, and search for the artery with much greater success, as now the flat of things is no longer concealed under a continual stream of blood.

As soon as the wounded portion of the artery is discovered, it ought not to be extenively dissected and separated from its surrounding connections in order to let the surgeon pass his finger under it. This mode of proceeding is now acknowledged by some of the best surgeons to be unnecessary and injurious; and it will be quite sufficient to separate the artery sufficiently to pass an eye-probe or aneurinal needle under it, with which a double ligature is to be drawn beneath it. The probe or needle having been cut off, one ligature is then to be tied above the aperture in the artery, and the other below it. Were only a single ligature applied above the wound in the artery, the bleeding would still be kept up, because the blood passes into the lower continuation of the vessel through numerous large anastomoses, in a quantity that is truly surprising.

The principles which should guide the surgeon in the use of the ligature, were not known until the late Dr. Jones published his valuable treatise on hemorrhage. As an able surgeon has observed, "he has banished the use of thick and broad threads, of tapes, of referve ligatures, of cylinders of cork and wood, linen compresse, and all the contrivances, which, employed as a security against bleeding, only served to multiply the chances of its occurrence." Lawrence in Medico-Chir. Tranfol. vi. p. 162.

In the article SURGERY, we have noticed the method of cutting off both ends of the ligature close to the knot on the face of the stump, with a view of lessening the quantity of extraneous matter in the wound, and promoting a complete union of the divided parts, without any suppuration. The period of the first invention of this method appears uncertain. Mr. Hennen, who seems to have been the first who adopted the method in the army, had it suggested to him in 1813 by a Mr. Hume, as the practice of some American naval surgeon; and he has since found that it had been done in Scotland 16 years before the above year. Dr. Ferguson also saw the practice adopted in Sweden as early as the peace of Amiens. Mr. Hennen mentions 34 amputations, in which this treatment was followed by feces. His accounts are highly in favour of the method. See Hennen's Military Surgery, p. 189, &c.

This plan has been tried by Mr. Lawrence: "The method I have adopted (says this gentleman) consists in tying the vessels with fine silk ligatures, and cutting off the ends as close to the knot as is consistent with its security. Thus the foreign matter is reduced to the insignificant quantity, which forms the noose actually surrounding the vessel, and the knot by which that noose is tightened. Of the silk which I commonly employ, a portion sufficient to tie a large artery, when the ends are cut off, weighs between 1/10th and 1/10th of a grain; a similar portion of the thickest kind I have tried weighs 1/10th of a grain, and of the flaccid 1/10th."

Mr. Lawrence states, that the kind of silk twist which is commonly known in the shops by the name of dentil's silk, and which is used in making fishing-lines, is the strongest material, in proportion to its size, and therefore the best calculated for our purpose, which requires considerable force in drawing the thread tight enough to divide the fibrous and internal coats of the arteries. This twist is rendered very hard and stiff by means of gum, which may be removed by boiling it in soap and water; but the twist then loses a part of its strength. The flouret twist which Mr. Lawrence has used, is a very small thread compared with ligatures made of inkle. The quantity of such a thread necessary for the noose and knot on the iliac artery weighs 1/10th of a grain; or, if the gum has been removed, about 1/10th. But the finest twist kept in the flouret shops is strong enough in its hard flate for any surgical purpose; and the noose and knot, according to Mr. Lawrence's statement, would not weigh 1/100th of a grain.

It farther appears from the report of this gentleman on the subject, that there is no danger of these ligatures cutting completely through the vessel, as some surgeons have apprehended; and that although he has not yet ascertained what becomes of the pieces of ligature after the wound is united, he has never seen absces nor any other bad symptom occasioned by them. At the time when Mr. Lawrence wrote, he had employed this method of securing the arteries in ten or eleven amputations, in six operations on the breast, and in the removal of two fistulas. The cases all did well, excepting a man who lost his thigh, and who died of an affection of the lungs. See Lawrence on A New Method of tying the Arteries in Aneurism, Amputation, &c. in Medico-Chir. Tranfol. vi. p. 156, &c.

It merits notice, however, that the proposal of cutting off the ends of the ligatures close to the artery has not received the universal approbation of surgeons; and, in particular, Mr. Guthrie, of London, and Mr. Crofts, of Norwich, have urged objections against the practice. The former gentleman, at the same time, does not entirely condemn the method, but merely argues that it is liable to inconveniences, when adopted in wounds which are to be healed by the first intention. See Obs. on Gun-shot Wounds of the Extremities, p. 93.

Professor Scarpa also, whole experiments lead him to prefer large ligatures and intervening substances between them and the vessel, must be numbered amongst those who disapprove of the new plan. Like all his writings, the memoir which he has recently published respecting the ligature of arteries is highly interesting, and drawn up with the greatest candour.

Mr. Crofts, of Norwich, is more decidedly adverse to this new practice; and he finds his objections chiefly upon some
WOUNDS.

Some experiments which were made upon animals, and which, he conceives, justify the following conclusions:

First, If the wounds do not unite by the first intention, the ligatures may escape with the discharge, without any inconvenience.

Secondly, If common ligatures of twine are cut short, the wound may unite over them, and they may be found in abscesses after an interval of many weeks.

Thirdly, If the finest darning's silk be employed in the same way, the wound uniting over it, the ligature may be detached from the vessel, and remain buried in an abscess, where it will be found at different periods, from one to seven months; and this may happen whether the vessel be firmly compressed with a single ligature, or divided between two ligatures, so as to imitate the circumstances under which vessels are tied after operations.

Fourthly, If Indian silk, fine as hair, be put round a vessel, so as to diminish its diameter, or to effect its obliteration, by just compressing its fibres together, it may remain in this situation without exciting abscesses, or producing any inconvenience. The ligature may be thus applied to compass an artery for the cure of aneurism; but not to secure vessels divided in operations. If a thin ligature be drawn sufficiently tight upon a vessel on the face of a stump to be secure, Mr. Crofis is persuadeid, that the extremity of the vessel, which becomes inflamed as it were, must die. (See London Med. Repository, vol. viii. p. 363.) In one case of amputation also, in which the practice was tried, the stump was long in healing, and several small abscesses repeatedly formed.

On the other hand, we must take into consideration, that M. Delpreach, of Montpellier, has practised it to a considerable extent for several years past, without any inconvenience. Mr. Roux has also tried the plan in three operations on the breast; the cases did well, and no ill consequences arose from the absence of the parts of thread under the cicatrice. See Relation d'un Voyage fait à Londres en 1814, ou Parallèle de la Chirurgie Anglaise avec la Chirurgie Françoise; Paris, 1815, p. 124-130.

Mr. Hennen, in answer to Mr. Guthrie, also observes, that in the cases where it was tried at Bilboa, neither pain, heat, nor tumour, nor irritation, nor formation of pus, could be fairly traced to the short cut ligatures, which would not in all human probability as readily have succeeded to the ligatures usually employed; while, on the contrary, the progress of healing has been far more rapid where they have been used." Obs. on Military Surgery, p. 193.

Since Mr. Lawrence communicated to the Medical and Chirurgical Society of London the description of a "New Method of tying the Arteries in Aneurism, Amputation, and other Surgical Operations," he has constantly employed the method therein proposed, both in St. Bartholomew's hospital and in private practice; and, as he informs us, he has now tried it in many operations of almost every description. "The general result of my experience is (says he), that this plan, by diminishing inflammation and suppuration, and simplifying the process of dressing, very materially promotes the comfort of the patient, and the convenience of the surgeon, while it has not produced ill consequences or any unpleasant effect in the cases which have come under my own observation.

"I have found in my own practice, what has been confirmed by others, who have communicated to me the result of their experience, that the small knots of silk generally separate early, and come away with the discharge; that where the ligaments have united by the first intention, the ligatures often come out rather later, with very trifling suppuration, and no painful inflammation; and that, in some instances, they remain quietly in the part.

"In two or three instances, I have been told that the ligatures seemed to have caused irritation and pain. These were amputations; and we are accustomed to see effects, quite as considerable as were alluded to here, produced by the state of the bone and other causes, where the ordinary method of securing the arteries is practised; so that I could not, on close inquiry, find any reason to attribute what was complained of to the use of the silk ligatures, and the practice of cutting off their ends close to the knots." Medico-Chir. Trans. vol. viii. p. 490.

Mr. Lawrence contends, that under some circumstances the method will be attended with peculiar advantages, as in crowded military hospitals, where the destructive hospital gangrene either exists, or may make its appearance. Every measure tending to accelerate the union of wounds, whether after operations or under other circumstances, is of great importance in averting the probability of this calamitous occurrence.

This mode of cutting off both ends of the ligature close to the knot has now been successfully applied to operations for aneurism. Mr. Lawrence has himself found it answer his expectations; and we learn, that Mr. Carwardine, of Thaxted, tied the femoral artery with a small silk ligature, in a case of popliteal aneurism, and cut off the ends close to the knot. The wound united entirely by the first intention, not a particle of pus having been formed at any time; and it continued perfectly fixed at the distance of some months from the operation. Op. cit. p. 492.

If this practice prove generally benefical in operations for aneurism, there can be no doubt it will also be advantageous in other cases, in which the surgeon is called upon to cut down to and take up punctured or partially divided arteries in accidental wounds.

Although doubts are yet entertained by some practitioners, whether this new method of applying ligatures is entitled to praise and imitation, all surgeons are unanimous about the propriety of lefening as much as possible the quantity of extraneous bodies in wounds; hence, even they who disapprove of cutting off both ends of the ligature close to the knot, sanction and adopt the practice of cutting off one-half of each ligature close to the vessel, as the other portion will suffice for the removal of the knot and noose as soon as they are detached from the tied artery. When the wound is brought together, the ligatures are to lie in the nearest interstices left between the plasters.

2. Of the Removal of Clot of Blood, extraneous Substances, foreign Bodies, &c, from the Wound.—This forms the second indication to which the attention of the surgeon is particularly required, when he is first called to an incised wound. It is, indeed, an object of very material importance, because if it be not attended to, the wound may be brought together as nicely, as accurately, and as skillfully as possible, and every thing look well in the beginning; yet that desirable event, union by the first intention, will not follow, but instead of it a severe degree of pain, considerable swelling of the circumference of the laceration, extensive reodus, and suppuration and abscesses. All these fever and untoward consequences arise from the irritation produced by the presence of foreign bodies in wounds; and as an incised wound can generally be examined with the utmost facility, and made properly clean, without putting the patient to much pain, the neglect on the part of the surgeon becomes the more blameable. In other deep, narrow, lacerated wounds, and in many gun-shot injuries, it is often difficult at first to ascer-
tain whether there are extraneous substances in the flesh or not; but in open incised wounds no such difficulty and ob

secuity prevail, and the practitioner who cloes them, with

out having assured himself that they are perfectly free from all extraneous matter, betrays either the most supine negligence, or an utter ignorance of his professional duty. It is true an incised wound made with a clean, sharp instrument, which has not broken, can obviously have no foreign bodies in it. But very considerable and dangerous cuts are often produced by glass, china, &c. which are apt to break at the moment, and leave some of their fragments in the part. Sometimes also the weapon with which the wound is made is unclean, and occasionally dirt, gravel, &c. get into the wound, in consequence of the patient falling upon the ground at the time when he receives the injury. We shall merely repeat, that as extraneous bodies operate as an irritation to all kinds of wounds, the surgeon ought to take care to remove them immediately the bleeding vessels have been secured.

Mr. John Hunter believed, that blood retaining the living principle was rather an useful substance in the union of wounds than otherwise; and he only considered blood, which had been deprived of this principle by long exposure, the effect of impurities, &c. as hurtful, when left on the surface of the wound. Yet this is a doctrine which is by no means sanctioned by the approbation of the best modern practitioners, all of whom are decidedly of opinion, that leaving any blood upon the surface of a recent wound, when the opposite surfaces of such wound are to be brought into contact, is disadvantageous, retarding the cure, and rendering union by the first intention less certain. The presence of blood in the cavity of the wound, indeed, must have the effect of producing a greater or lesser separation of those surfaces, which ought strictly to touch each other; and we decidedly believe, that the practice of freeing wounds as much as possible from clots of blood may be successfully defended both upon theoretical and practical principles.

3. Union of the Wound, Dressings, &c.—We have said, that when the surgeon has stopped the bleeding, removed extraneous substances, and properly cleaned the wound, the next indication is to bring the opposite sides of the injury into contact with each other, and keep them quietly and steadily in this position until they have grown together again. Wounds are healed by two processes; viz. by one, in which pus is produced, and granulations and new skin are formed; and by another, in which, if it perfectly and universally succeeds, no suppuration whatsoever takes place. The latter, when it can be practised, is always the most desirable, because it is not only the quickest means of cure, but also the most perfect; the part being covered by the old original skin, which is always stronger and less disposed to ulceration than what is new formed. Surgeons have termed this way of healing wounds Union by the First Intention, (see the last words,) or Adhesion; and Mr. Hunter named the process by which it is brought about, together with many other analogous effects, was accomplished in the animal body, the Adhesive Inflammation. See Inflammation.

The great recommendations of union by the first intention are, celerity of cure, the diminution of the pain and inflammation arising from the exposure of raw surfaces, freedom from the inconveniences of suppuration, the prevention of the deformity, which would otherwise result from a large cicatrix, and the greater permanency and soundness of the cure, for the reasons above stated.

The strong tendency which divided parts of the animal body have to grow together, when kept a certain time in contact with each other, is an important fact, of which the moderns have taken much more advantage than the ancients. There are even cases and experiments on record in support of the opinion, that it is not entirely impossible for parts entirely detached from the rest of the body to become united again, if quickly replaced. In the article Union by the First Intention, we have noticed the interesting experiments made by Duhamel and Mr. Hunter. The researches of the latter celebrated philosopher brought to light several very curious and instructive facts. He proved that the telodices of a cock, when removed and introduced into the abdomen of a ben, contracted a vascular connection with the surface of the viscera, and lived. He ascertained, that a found tooth might be transplanted from its socket, and acquire an union to the alveolar processes of another person. He also cut off the spurs of a young cock, and found that they might be made to unite to its comb, or that of another cock, and grow in such situation. The possibility of this species of union shews how strongly the disposition of the fresh surfaces of an incised wound must be to grow together; particularly when it is considered, that in the foregoing and in some of the following instances, there can be on one side no affiance given to the union, as the part entirely separated from the rest of the body is hardly able to do more than preserve its own living principle, and (as Mr. Hunter expresses himself,) accept of union.

The following observations on this subject are taken from professor J. Thomson's excellent book on inflammations: "Besides those examples that are seen in the transplantation of the teeth, it must be confessed, that innumerable instances of the reunion of parts which had been entirely separated are very rare in the human body; fo rare, indeed, that most practitioners still treat with disbelieve and ridicule the few instances which have been put upon record. But the different facts which have been learned respecting the transplantation of the teeth, together with the experiments of Duhamel and Mr. Hunter, prove indisputably the possibility of parts being re-united which have been completely separated from the animal system to which they belonged, and in which the circulation of the blood must necessarily have ceased for a time. There is nothing therefore in the nature of the fact recorded, that can justify us, I conceive, (says Dr. Thomson,) in doubting the veracity of those, by whom familiar instances of re-union between other parts of the body have been related.

"That practitioners have generally failed in effecting this re-union, is frankly acknowledged by those who have related cases of it very extraordinary. I shall mention to you (continues this author) a few of those rare cases, and leave it to your own judgment to deduce from them the conclusions, which the characters of the authors by whom they are related, and the nature of the facts themselves which they relate, may seem to you to warrant."

"The first example of this kind which I find distinctly recorded is by Phiorovant, in the 54th page of his second book of the Secrets of Surgery: 'In that time, when I was in Africa, there happened a strange affair: a certain gentleman, a Spaniard, that was called Signor Andrea Gutierrez, of the age of twenty-nine years, upon a time walked in the field, and fell at words with a tailor, and began to draw. The tailor seeing that, struck him with the left-hand, and cut off his nose, and there it fell down in the sand. I then happened to stand by, and took it up, and piffed thereon to walk away the sand, and dressed it with our balsamo artificiali, and bound it up, and so left it to remain eight or ten days, thinking that it would have come to matter; nevertheless, when I did unbind it, I found it fast conglutinated, and then I dressed it only once more, and he was perfectly whole, so that all Naples did wonder thereof, as is well known;
known; for the said Signior Andreas doth live, and can tell the fame.'

"Bligny, in his Zodiacus Medico-Gallicus, for the month of March, 1660, mentions a cafe, in which a nofe that had been cut off with a fafe was replaced by a military furgeon of the name of Winfaunt, and in which a perfect re-union was obtained, he affirms, by the use of flitches, and of agglutinating plasters.

"A third cafe of the fame kind is related by Gaengetot, at the 55th page of the third volume of his Operations of Surgery. * In the month of September, 1724, a foilder of the regiment of Conti, coming out of L'Epée Royale from an inn, at the corner of the street Deux-Ecus, was attacked by one of his confrères, and in the struggle had his nofe bitten off, fo as to remove almost all the cartilaginous part. His adversary perceiving that he had a bit of flesh in his mouth, flat it into the gutter, and endeavoured to crush it by trampling upon it. The foilder, who on his part was not left spirited, took up the end of his nofe, and threw it into the shop of M. Galm, a brother-practitioner of mine, till he should return after his adversary. During this time, M. Galm examined the nofe that had been thrown into his shop, and as it was covered with dirt, he washed it at the well. The foilder returning to be dreffed, M. Galm washed his wound and face, which was covered with blood, with a little warm wine, and then put the extremity of the nofe into this liquor to heat it a little. Having in this manner cleaned the wound, M. Galm now put the nofe into its natural situation, and retained it there by means of an agglutinating platter and bandage. Next day the re-union appeared to be taking place; and on the fourth day, I myself dreffed him with M. Galm, and saw that the extremity of the nofe was perfectly re-united and cicatrized.

"These (says professor Thomfon) are the only cafes which I have been able to find distinctly stated of the re-union of a nofe which had been completely cut off. This event, from analogy, we have reafon to believe is poitible, and nothing short of a contrary testimony in the infances I have related could justify us, I conceive, in denying the truth of the fact."

Dr. Thomfon then details a cafe, extrated from vol. xiii. of the Journal de Médecine, where the point of a finger which had been cut off was re-united by M. Boffu, furgeon at Arras. Dr. Thomfon also mentions, that he has been informed by different persons entitled to credit of a coniderable number of cafes similar to the preceding, in which the points of fingers and toes completely separated were afterwards re-united.

Although it must be acknowledged that the foregoing cafes of the union of parts completely severed from the body are uncomonly, the fame obfervation does not apply to infances in which the detached part still retains a partial and flight connection with the rest of the body, by means of either only a few fibres or little bit of skin. "Many cafes," says Dr. Thomfon, "are upon record, and many more have been observed, in which parts have re-united, which were divided all to a very small portion of cutis, a portion so small that it is not easy to conceive that any effeétual circulation could be carried on through it; and in these cafes it deserves to be remarked, that it was generally the nofe, or the extremities of the fingers and toes, which re-united, after having been separated and replaced. I have seen two examples of the re-union of the nofe, where it was almost entirely separated. In one of them it adhered only by the skin of one of the alae, and in the other chiefly by the leptom. Arcæus mentions a cafe in which the nofe, with molt of the upper jaw, was fo separated as to hang down upon the chin, and yet a re-union was effected. A cafe is mentioned by Lombard, in which the nofe, nearly cut off and unplaced for some hours in winter, was made to re-adhere by fitching and proper dressings. Another cafe of the fame kind occurred to Lombet." [Lectures on Inflammation, p. 243.] In the Dictionary of Practical Surgery, an infance is mentioned, in which an ear that had been completely separated from the head, with the exceffion of a small bit of skin, was united again with the aid of a future; and Dr. Thomfon has himfelf seen portions of the little toe and little finger, after being nearly cut off, successfully re-united.

The knowledge of all these facts cannot but prove ufeful in the practice of surgery, inasmuch as it teaches the practicioner to attempt the union of parts, under circumstances which would otherwife appear entirely hopelefs and difcouraging.

In promoting union by the firft intention, surgery is merely to officiate as the handmaid of nature. There are only two indications to be fulfilled: the firft is to bring the edges of the wound into reciprocal contact, and keep them fo; the other is to avert the acces of immediate inflammation, by which the agglutination of the wound would certainly be prevented. The firft object is accomplished by a proper position of the wounded part, by bandages, by adhesive platter, and by futures. The second is fulfilled by a firft obfervance of the antiphlogiftic regimen, and particularly by avoiding every kind of motion and disturbance of the wound. The reft is the work of nature.

The position of the part is to be regulated on the principle of relaxing the wounded integuments and mufcles. If the extenfor mufcles are injured, the joints which they move ought to be placed in an extended poifure; if the flexor mufcles are wounded, the limb is to be bent. When the integuments alone are cut, the fame poifure which relaxes the mufcles situated immediately beneath the wound also serves in general to relax the skin. In tranverse wounds of muscular fibres, it is a liftening that immense effect the obfervance of a proper poifure produces. This is never to be neglected, whatever may be the other means adopted.

Bandages may frequently be made to contribute very effenitionally to keeping the sites of wounds duly in cufpect with each other. This is strikingly illuftrated in cafes of harelip, where we fee that the opposite edges of the effure may be brought foward fo as to touch, and be maintained in this poifion by the simple ufe of compreffes and a bandage. Such was the mode of treatment preferred by M. Louis after the operation for the harelip, and were it not for the greater convenience and certainty of the twiffled future, it is the plan to which surgeons would yet have recourse. (See Harelip.) The uniting, or, as it was formerly named, the incarnative bandage, is one which operates in keeping the opposite surfaces of wounds accurately applied to eacller, fo that the opportunity may be afforded for them to unite and grow together again. The common uniting bandage can only be used in wounds which take a direction correfponding to the length of the body or limbs, and which are situated where a bandage can be employed with convenience and effeét. It consists of a double-headed roller, having a fit between the two heads. The fit must be sufficiently large to allow one head of the roller to pass through it with facility. The wound having had the requisite dressings put on it, the furgeon is to take one head of the roller in each hand, and apply the bandage to that part of the limb which is oppofite the wound. One head of the roller is then to be brought round, fo as to bring the fit over the branch of continuity. The other head
head is then to be brought round in the opposite direction, and passed through the slit. The bandage is now to be drawn moderately tight, and its two heads being carried round the limb again, the same artifice is to be repeated. A sufficient number of turns of the roller must be made to cover the whole length of the limb.

When the wound is deep, it is recommended to place small longitudinal compresses beneath the roller, at a little distance from the edges of the wound.

As the uniting bandage can only be made use of for longitudinal wounds, which never have a considerable tendency to gape, nothing can be more absurd than the application of it with immediate tightness. By such cruel and injudicious practice, many a limb and life have been lost; for, if the bandage be very tight on its first application, what a dangerous contraction of the limb or part must follow, when the swelling, necessarily arising from the wound, has had time to come on. It is thus that insufferable pain, gangrene, and phæochus, have frequently been brought on, when, if the part had been simply dressed and left unconfined, every thing would have gone on most favourably. It is right to flate, however, that modern surgeons are not partial to the uniting bandage, and we freely declare our conviction, that it is a means which may very well be dispensed with in practice.

If it has any advantages, they consist in its having more power than the adhesive platter alone to maintain the opposite sides of deep wounds in contact, and in its acting without the irritation frequently arising from the application of refrinous substances to the skin. It is not, however, exempt from serious inconvenciences. Its total concealment of the wound, its lying in irregular folds, so as to create an uneven cicatrix, and the preflure and contraction attending its ufe, &c. might be mentioned. (See fril Lines of Surgery, p. 68. edit. 3.) So little is the uniting bandage now employed, that although we have seen thousands of wounds, we have not noticed its use in a single instance during the last twelve or fifteen years. When preflure can be made to affift the other dressings, surgeons almost always resort to compresses and a simple roller. In a few particular cafes, in which the limb would be too much disturbed by the application and removal of a common roller, the eighteen-tailed bandage is to be preferred. See Bandage, and Fracture of the Thigh.

Adhesive platter may be laid to be the most common means employed in the practice of surgery for bringing the edges of wounds together. When used for this purpose, it was sometimes technically called by the old surgeons the dry future, in opposition to futures strictly so named, which are usually made with a needle, and are invariably attended with a degree of bleeding. It was at one time suppoled, that adhesive platter could be of no material ufe, except in superficial wounds of the skin. It is true, that adhesive platter has no direct effect in bringing together the sides of a deep muscular wound; yet we ought to recollect, that by drawing the integuments over the deeper part of the injury, it at once prevents the continuance of the exposed state of the cut surfaces, under which suppuration would unavoidably follow. Nor does the ufe of adhesive platter hinder recourse to other measures more calculated to bring the opposite surfaces of the deeper part of the wound into contact, such as the observance of a proper position, and the ufe of compresses and a bandage. It is also an error to suppose that adhesive platter cannot be ufed in situations where hair grows, or where it will soon become wet. If the part be well shaved, and perfectly dried at fiit, the application will not become loose so soon as to prove ineffectual. In such instances, the platter should be very fresh, and its quality may be made rather more adhesive than in ordinary cafes.

Adhesive platter is generally applied in strips, between every two of which an interlace is recommended to be left, for the purpose of allowing any discharge to escape. To bring the edges of the wound effectually together, and at the same time to leave a little room for the exit of the discharge, are the objects to which we ought particularly to attend in the employment of adhesive platter: hence, when the strips are broad, it is not unfrequent to cut out an oval piece of each strip just where it crosses the line of the wound. Equal parts of the emplastrum plumbi, and of the emplastrum refine, form the composition generally used in this country for adhesive platter. They are melted over a flow fire and well mixed together, after which they are spread upon linen with a warm spatula.

Sutures, or Stitches, are of several kinds, but the only one which is now generally employed in the cure of wounds is the interrupted future. The guiled future is rarely used at present, though it was formerly much in favour, and is not yet passed over by ylomematic writers. As a description of these futures has been given in a separate article (see Suture), we shall not repeat the particulars of the manner of making them. The twisted future is not unfrequently preferred for holding together the edges of cuts in the face, where the parts are liable to be in almost constant motion, and where the avoidance of the disfigurement of a large scar is peculiarly desirable. This is the future which is always employed in the cure of the Harelip, in which article a description of it will be found. These, and a future called gaihorrize, which will be noticed in speaking of wounds of the abdomen, are all the kinds of futures which are ever employed by modern practitioners. The Glover's future, or continued flitch, is now nearly rejected from practice, and confined to the sewing up of dead bodies; a purpose for which it is better adapted than for the union of any wound in a living subjct.

On the subject of the propriety and advantage of using futures, as a means of keeping the sides of wounds in contaft, much diversity of sentiment has prevailed. Some surgeons, especially M. Pibrac and M. Louis, have urgently recommended their entire discontinuance, and their observations are accompanied by facts which must have considerable weight. Their opinions and arguments, we acknowledge, have constantly influenced us in practice; and if we do not join in the sentiment, that futures ought to be entirely abandoned, we at least believe that they are still a great deal too much ufed. M. Pibrac and M. Louis, however, are entitled to great praise for havingjeffenced the employment of needles in surgery; and though there are few instances in which the utility of futures appears to be confirmed by experience, there are many others in which the practice is altogether unnecessary and injudicious. "The practice of stitching," says Dr. Thomson, "is undoubtedly much less followed at present than in any former period of the surgical art; and unles in superficial wounds, where we wish to heal by the first intention, or in wounds where (as in those of the abdomen) it is necessary that the edges should not be allowed to separate from each other, the ufe of stitches may be, in most instances, advantageously superseded by adhesive platters and proper bandaging. It is by limiting the ufe of futures, not by procuring them altogether, that the surgeon is likely to derive advantage from the employment of means so powerful." (See Lectures on Inflammation, p. 287.) There are certainly hardly any two surgeons who think exactly alike about the uces in which futures
WOUNDS.

The flatters are truly benefical or not. Thus we do not admit that they ought to be used as frequently as the remarks of the above distinguished professor would warrant; and the majority of superficial wounds, in which union by the first intention is indicated, certainly, so far from being benefited by futures, would be injurious. Further observations, however, on this subject will be found in the article SUTURE.

When futures are judged necessary, their operation is always assisted by the application of suitable compresses and a bandage, the good effects to be derived from position of the part being also not neglected. The flatters ought in general to be removed between the third and seventh day; for if they are allowed to remain longer, or even in some cases so long, they excite inflammation, and sometimes ulceration.

Such then are the means which surgeons adopt for keeping the opposite surfaces of wounds in contact, until an union has taken place. When the parts grow together again without any suppuration, the mode of cure, as we have already explained, is well known to surgeons by the term union by the first intention. Of the nature of this process, and of the way in which a connection is established again between the parts which have been divided, we have endeavored to give some account in a preceding volume; we shall not, therefore, expropriate on the subject. See UNION by the First Intention.

The first flatters and dressings applied with a view of bringing about this desirable method of cure, should be allowed to continue at least three or four days, unless any untoward symptoms, such as excessive pain, the renewal of hemorrhage, &c. indicate the contrary. The severity of the pain is sometimes owing to the future, sometimes to the immoderate tightness of the roller, and occasionally to there being extraneous substances yet lodged in the wound.

When too much inflammation is apprehended, the bandage should never be tight; and wetting it with cold water may be of use by keeping the parts cool. Perfect quietude, and the usual antiphlogistic remedies, are also not to be omitted. The old plan of covering the dressings with thick woolen rollers, caps, and large mafles of tow, has gone very much out of fashion, as being inconsistent with those principles which are recognized by every scientific surgeon as best calculated to arrest and lessen inflammation.

When the first dressings are removed, the surgeon often finds union by the first intention only accomplished at certain parts of the injury; and the connection, even there, still requires further support. However, when the wound is dressed again, it is generally unnecessary to apply as many trips of adhesive plaster as were employed in the first instance. Their number may be gradually lessened at each future dressing. The future, if there be any, should also be now withdrawed, as they will do no more good, and their continued presence may excite irritation and do harm. Suffice it to add, that throughout the subsequent treatment the reft of the dressings should be light, simple, and unirritating.

Of the Cure of Wounds by Granulations, &c.—We remarked, that wounds are healed by two processes, one of which was not attended with the formation of pus, was the quickest and most perfect in its effects, and was called union by the first intention, or adhesion. The other processes now requires description. "When, in the treatment of a wound," says professor Thomson, "the re-union by adhesion, or by the first intention, has either not been attempted at all, or, if attempted, has failed, nature brings about a cure by that slower and more complicated operation, which we now denominate the process of granulation; a process termed (as we have already remarked) by Galen re-union by the second intention. By many of the older surgeons, this mode of healing wounds is described by the appellation of fffarefti, or concarnation, terms perhaps less liable to objection than that of granulation, which, in strict propriety, is a term expressive of only one of the stages of this mode of re-union, and which, of course in order to avoid all ambiguity in the language we employ, ought not to have been used as a general term for the whole. In re-union by the second intention, the edges of the wound swell and inflame more than in the process by adhesion; but, as in that process, so in this, a layer of coagulable or organized lymph is thrown out upon the divided surfaces. This layer is soon penetrated by blood-vessels, and, like the intermediate in adhesions (see UNION by the First Intention), becomes an organized and living substance. So that these modes of re-union are similar; but in a short time after this layer of coagulable lymph has been thrown out upon the open and exposed surfaces of a wound, there is thrown out also upon the same surfaces a quantity of pus, or the matter of fores. This fluid, like the coagulable lymph, is the immediate product of a change induced in the action of the capillary vessels existing in the divided substances of the wound, a change by which they seem to become secreting instead of circulating tubes. The action by which pus is formed is now denominated suppuration: the old surgeons gave to it the name of digesstion. See SUFFURATION.

"When the surfaces of the wound have been feverly injured, or when the patient is of a bad habit of body, a greater or less portion of these surfaces losing its vitality, separates from the remaining found part, and comes away in the form of a slough. The older surgeons, who are more minutely accurate in the descriptions which they have left us of diseased appearances, call this the detached or mummification of the wound: the surgeons of the present day, sloughing, or the separation of the slough. See the article GANGRENE.

"In the healthy conditions of the body, and when the edges of the wound are uninjured, the smooth surface of the layer of coagulable lymph which covers the bottom of the wound is, in the course of a few days after the suppuration has taken place, raised into a number of small eminences, like grains or papillae. These little eminences are termed granulations, and their formation in the healing of wounds, the process of granulation. By the older surgeons, this step, in the process of re-union by the second intention, was commonly termed incarnation, or concarnation, terms expressive of the formation of a portion of new flesh." See GRANULATION.

"On the surfaces of these granulations, but most frequently on the edges of the wound next to the skin, small white specks appear; the quantity of pus which is secreted gradually diminishes, and the bluish-white specks, by continuing to increase in number and size, come at last to cover the surface of the wound. On examination, the surface of the wound will now be found to be covered by a kind of new skin and cuticle. The formation of this new skin has long been denominated the process of cicatrization, and the process of re-union by the second intention being now fully accomplished, the wound is said to be completely cicatrized." Thomson's Lectures, p. 288.

The re-union of a wound by the first intention is the work of one, two, or three days; while re-union by the second intention always requires a period of several days, and sometimes in diseased constitutions, or parts which have been much injured, of months, or of years. Thomson, p. 290.

As the same well-informed writer remarks in another place,
place, most wounds admit of being healed partly by adhe-

sion, and partly by the processes of granulation. We have
very good examples of this in the wounds made in ampu-
tation of the extremities, and in the extirpation of the
mamma, or of other large tumours. We know, or at least
we have reason in these instances from the first to sus-
pect, that the whole of the wound will not heal by adhe-
sion; but we are ignorant whether a large or a small portion will be
healed by that process; and accordingly, we at first pro-
cede in the dressing of such wounds, as if we expected or
intended that the whole should heal by adhesion. We
bring the edges of the wound together by adhesive fraps,
or flitches, and support these by proper bandaging. The
adhesive flaps are of great use even in those wounds in
which it is impossible to bring the edges at first into contact.
They bring and retain the edges near each other; they
diminish the size of the wound; they keep surfaces in con-
tact which have a disposition to adhere; and ultimately, by
the gradual elongation of the old skin, even where the
differences between the sizes is at first considerable, they
p. 293.

With respect, however, to the particular mode of dress-
ing wounds which are to heal by granulations, it seems
unnecessary to enter into any long detail in the present
place; because the treatment is to be conducted on the
very same principles which apply to fores, and which we
have so fully explained in another article. See ULCE.

We shall conclude this section of the subject of wounds
with a few useful rules, which professor Thomfon recom-
mends to be observed in the dressing and examination of
these cases.

In examining or dressing a wound, we ought never to
give the patient more pain from our modes of procedure,
or methods of dressing, than is absolutely necessary for his
present good and future security. For instance, we ought
never to probe a wound where probing can be of no use;
and we should be contented to remain ignorant of those
things, the knowledge of which could only gratify an idle
curiosity.

Another good rule is, to have all the fresh dressings per-
fectly ready before the removal of those which have been
previously applied. A sponge and warm water, adhesive
fraps, pledges of various ointments, lint, compresses, and
bandages, are to be at hand, and not to be sought for at
the very moment when they are required for use.

As in many instances the removal of the dressings, and
the application of others, take up a considerable time, we
ought carefully to reflect what the position is which will
be most easy to the patient, and at the same time most con-
venient to the surgeon.

When the bandage, adhesive plaster, and other dressings,
have become hard and dry, and glued together, and to the
surrounding skin by blood, or other discharge from the
wound, the surgeon should soften and loosen the applications
by wetting them a sufficient length of time with warm
water, which is to be pressed out of a sponge upon them,
a basin being held below the part for the reception of the
water as it falls off the dressings. This duty is of much
importance in saving the patient from a great deal of
gony, which the abrupt removal of the adherent dressings
would produce.

In removing the dressings which are under the bandage,
we must be careful that the ligatures are not entangled, and
that we do not pull them forcibly away. Pulling at the
ligatures during the first dressings, as professor Thomfon
remarks, always occasions pain; and if, in removing the
dressings, the threads be incautiously torn off, a greater or
lesser degree of hemorrhage may be produced, and much
dilatation, if not danger, occasioned. To avoid this accident,
therefore, we ought always to search for the ligatures pre-
vious to the removal of the dressings, and to separate them
from these dressings when they adhere, as they most fre-
quently do.

Having formed and separated the ligatures, we must next
proceed to remove the adhesive fraps by which the edges of
the wound are more immediately kept in contact. It
mostly happens, that a greater or lesser portion of these fraps
is loosened from the surface of the wound by the fluid
which exudes from it. This is the part, therefore, from
which (says Dr. Thomfon) we should first proceed to sepa-
rate these fraps, because it is here that the edges of the
wound may be supposed to recede farthest from each other,
and the pus to have found the freest exit. But the manner
in which the remaining adhering portion of frap is to be
separated, is not, as may first appear, a matter of indifference.
There is but one way in which it can be properly taken off,
though it is one which is often neglected in practice. In
removing these fraps, we are always to lay hold of them
by the ends, first by the one, and then by the other end,
and to pull them off in the direction of the wound, taking
care never to raise the end of the frap much above the
level of the skin, nor to continue to pull by the end we
hold, after we have separated it as far as the wound. Were
the fraps pulled off in a direction from and not towards
the wound, the edges of the injury to which they adhere
would be drawn away from each other; the slight adhe-
sions which have formed between one side of the wound and
the other would be torn, and the processes of re-union dis-
turbed and retarded. If we raise the end of the frap, we
also tear the edge of the wound from the subjacent parts
to which it adheres.

Another good piece of advice given by professor Thomfon
is, that only one adhesive frap, or at most two, should be
removed at once; and the part from which it has been re-
moved being carefully wiped with the sponge, and dried
with a soft linen cloth, a fresh frap is always to be applied
before another is removed. It is from inattentive to this
rule that we see the surfaces of wounds and fores daily torn
open at each dressing, merely by the weight of the parts
which have just been united.

The edges of the wound, particularly if it be a large one,
should always be held together by an assistant during the
time of dressing.

When there are several wounds, only one is to be opened
and dressed at a time, so that all unnecessary exposure of
the parts may be avoided.

At each dressing care must be taken to prevent lodgments
of matter, by placing the compresses and fraps of plaster
in the manner best adapted to press upon and obliterate any
cavity in which the pus has a tendency to accumulate.

A pledge of some mild cerate or ointment is usually
applied over the adhesive plaster, and its size should exceed
that of the wound. It is preferable to dry lint, which be-
comes adherent, troublesome to remove, and often conceals
and sticks to the ligatures. If lint be necessary, it may be
employed over the pledge. Modern surgeons, however,
are far more sparing of thick masses of lint, tow, flannel-
rollers, &c. than their predecessors, as we have previously
explained.

On the subject of bandages we shall here add nothing to
what has been already stated in the foregoing section of this
article.

In the dressing of wounds, says Dr. Thomfon, particu-
larly
WOUNDS.

particularly in hospital practice, where frequent change of linen is not at all times obtainable, it is of great consequence to the comfort of the patient, and to the general health and welfare of the other patients, that every attention should be paid to cleanliness, and that every thing filthy and offensive should be removed from the room or ward as quickly as possible. Above all things, care must be taken not to let the matter touch the bed-clothes.

The frequency of dressing must be regulated by the quantity and quality of the discharge from the wound, by the situation of the injury, by the climate and season of the year, by the effects which the renewal of the dressings seems to produce, and by the feelings, and sometimes the wishes of the patient.

During the long-continued discharge of pus from many wounds, the strength of the patient must be supported, and granulation and cicatrization promoted by nourishing diet and proper cordials. The most disagreeable, and unfortunately not an uncommon termination of large wounds, is the formation of unhealthy granulations, attended with a general waffling of the body and hectic fever. See Thomson's Lectures on Inflammation, p. 294, &c.

Of punctured Wounds, or Stabs.—Punctured wounds are not only dangerous on account of their frequently extending to a considerable depth, and injuring important blood-vessels, nerves, and viscera, but they are also dangerous, inasmuch as they often give rise to violent and extensive degrees of inflammation. It is not uncommon to see formidable collections of matter follow wounds of this description, especially when the instrument with which they have been made has penetrated any aponeurosis, or fascia. Stabs and all other punctures are not simple divisions of the fibres of the body; they are attended with more or less contusion and laceration, according to the particular form of the weapon, and the degree of violence with which the thrust has been made. Hence there is not the same propensity to union by the first intention, which we observe in wounds made with sharp-edged instruments; and when ligamentous expansions are amongst the parts injured, it is not uncommon to see a train of fever, local and constitutional symptoms follow. Immense agitation of the nervous system sometimes ensues upon the infliction of a punctured wound; and it has been generally attributed to the injury of tendons or nerves. This doctrine, however, is now almost quite exploded, as surgeons so frequently see nerves and tendons wounded, without the occurrence of great constitutional disorder. The truth is, that alarming nervous symptoms do not follow punctured wounds in perhaps more than five cases out of a hundred, in which tendons and nerves of some size are actually injured. It cannot, therefore, be so much the injury of these parts, as other circumstances attending flabs, which are the cause of the fever indistinctness sometimes suddenly induced by such wounds. When they extend deeply, the consequences of the injury of large blood-vessels and viscera will often account for the great constitutional disorder, without having any recourse to doctrines like the foregoing.

Punctured wounds are frequently followed by the formation of deep-settled abscesses and sinuses, and hence the cure is often difficult, and sometimes it cannot be effected till after a considerable time.

With respect to the treatment of punctured wounds, we may observe, that in this part of practice erroneous suppositions have commonly led to many serious abuses. The unqualified idea, that the severe consequences of most punctured wounds are, in a great measure, owing to the narrowness of their oriFices, has induced numerous surgeons to practise indiscriminately deep and extensive incisions, for the purpose of rendering their external communication considerably wider. To have confidently in view the conversion of such injuries into simple incised wounds has always been a maxim strongly inflected upon, and let forth as the reason of the above method of treatment. The doctrine even occasioned the frequent dilatation of punctured wounds by the fluid more absurd and cruel means, the employment of tents.

Certainly, if the notion were true, that an important punctured wound, such as the flab of a bayonet, is actually changed into a wound partaking of the mild nature of an incision, by the mere enlargement of its orifice, the corresponding practice would be highly commendable, however painful it might be. But the fact is otherwise; the rough violence done to the fibres of the body by the generality of flabs is little likely to be suddenly removed by an additional violence—the enlargement of the wound. Nor can the distance to which a punctured wound frequently penetrates, and the number and nature of the parts injured by it, be at all altered by such a proceeding. These, which are the grand canals of the collections of matter which often take place in the cases under consideration, must exist, whether the mouth and canal of the wound be enlarged or not. The time when incisions are proper is, when there are foreign bodies to be removed, abscesses to be opened, or sinuses to be divided. To make painful incisions sooner than they can answer any end is both injudicious and hurtful. They are sometimes rendered quite unnecessary by the union of the wound throughout its whole extent, without the least suppuration.

It is true, as is observed in a modern publication, that making a free incision in the early stage of these cases seems a reasonableness method of preventing the formation of sinuses, by preventing the confinement of matter; and were sinuses an inevitable consequence of all punctured wounds, for which no incisions are practised at the moment of their occurrence, it would undoubtedly be unpardonable to omit them. Fair, however, as this reason for the use of the knife may appear to some practitioners, it is only superficially plausible, and a very little reflection soon detects its want of real solidity. Under what circumstances do sinuses form? Do they not form only when there is some cause exciting to prevent the healing of an abscess? This cause may either be the indirect way in which the abscess communicates externally, so that the pus does not readily escape; or it may be the presence of some foreign body, or dead portion of bone; or, lastly, it may be an indispension of the inner surface of the abscesses to form granulations arising from its long duration, but removable by laying open the cavity. Thus it becomes manifest, that the occurrence of suppuration in punctured wounds is only followed by sinuses, when the surgeon neglects to procure a free issue for the matter after its accumulation, or when he neglects to remove any extraneous bodies. But as dilating the wound at first can only tend to augment the inflammation, and render the suppuration more extensive; and as likewise the new incision may heal up by the first intention before it has answered any purpose at all; the practice should never be adopted in these cases, except for the direct objects of giving a free exit to matter already collected, and of being able to remove extraneous bodies palpably lodged in the part. We shall once more repeat, that it is an erroneous idea to suppose the narrowness of punctured wounds so principal a cause of the bad symptoms with which they are often attended, that the treatment ought invariably to aim at its removal.
Recent punctured wounds have absurdly had the fame plan of treatment applied to them as old and callous fistula. Setons and stimulating injections, which in the latter case sometimes act beneficially, by exciting such inflammation as is productive of the effusion of coagulating lymph, and of the granulating process, can never prove serviceable when the indication is to moderate an inflammation which is diffused to rife too high. The counter-opening, which must be formed in adopting the use of the fenton, is also an objection; and though French authors have given us accounts of their having drawn their setons across patients' chests, in cases of flabs, they will find some difficulty in making the practice seem unattended with harm, much les productive of good. The candid and judicious surgical reader should not always think a plan of treatment right because the patient gets well; for there is an essential difference between a cure promoted by really useful means and an escape, notwithstanding the employment of hurtful ones.

For our own part, we cannot see what good can ever possibly arise from the use of setons in cases of punctured wounds. Will a fenton promote the discharge of foreign bodies, if any happen to be present? By occupying the external openings of the wound, will it not be more likely to prevent it? In fact, will it not itself act with all the inconveniences and irritation of an extraneous rubbish in the wound? Besides, let it be recollected, that punctured wounds are rarely accompanied with the lodgment of foreign bodies. Is a fenton a likely means of diminishing the immoderate pain, swelling, and extensive suppuration so often attending punctured wounds? It will undoubtedly prevent the external openings from healing too soon; but cannot this object be effected in a better way? In most instances where much matter is collected, and where the suppuration is likely to last a long while, in conformance of exfoliations, there will be no chance of the sinus healing up prematurely; and if such risk should appear probable, it is always easy to maintain an external opening by the daily introduction of a probe into the sinus, and a small doffil of lint into its orifice. See First Lines of Surgery, edit. 3. chap. xvi.

When a surgeon is called to a punctured wound or flab, he may often form some opinion respecting the depth and nature of the injury by examining the weapon with which it was done, and observing how far the blood reaches along the blade from the point, and by attending to the quantity and quality of the fluids which may issue from the external opening. Thus, the escape of chyle or feces will denote that the bowels are injured; the effusion of urine will indicate that the bladder or some part of the urinary organ is wounded; and the flow of much arterial blood will prove that a considerable artery is opened. Wounds of the lungs will also be attended with particular symptoms, as we shall notice in speaking of wounds of the chest. In many instances, however, important viscera and large deep-seated arteries are injured by flabs, and yet no information can at first be deduced respecting what has happened from attention to local symptoms alone. The faintness and great sudden prostration of strength, the fainting, low, and intermitting pulse, the vomiting or coughing up of blood, and the coldness of the extremities, however, are still sufficient evidence that the cafe is complicated with injury of important organs, and that the patient is in a state of urgent danger. These are matters which will be best understood when we come to the consideration of wounds of the chest and belly, and therefore we shall not dwell upon them at present.

From what has been already stated, the reader must be aware that we do not follow the bulk of surgical writers in recommending the indiscriminate dilatation of the orifices of punctured wounds; nor do we admit the propriety of using the knife for the purpose of preventing mischief only expected and apprehended, but not actually existing. Whenever we have had an opportunity of attending bayonet or other punctured wounds, unattended with any particular complication, we have always observed nearly the same principles as are now so generally approved of in cases of gun-shot wounds. We have abstained from dilating the orifice of the injury, except when it was necessary either to get at a bleeding artery in the first instance, or to give a freer egress to the discharge in a later stage of the case. We have given the preference to mild, simple, unirritating, and superficial dressings. We have not placed much faith in the utility of enveloping the parts in a tight bandage; but, after applying the first superficial dressings, have usually covered the limb with linen, wet with the lotio plumbi aceti, or cold water. Whenever a roller was used, it was not with a view of making pressure, but of retaining the dressings. The wound having been dressed, we have then usually put in practice all such means as are generally deemed most efficient in preventing and diminishing inflammation; such as veneséction, the exhibition of aperient and saline medicines, low diet, &c. When the pain was very severe in the beginning, we have prescribed opiates, and on the acced of much swelling, have always been careful to let the bandage be slack. We believe that, on the whole, the application of superficial dressings and cold washes is mostl the best practice for the first twenty-four hours after the receipt of a punctured wound. But if after this period the pain should appear to increase, and the swelling to become more and more considerable, the surgeon may then remove the bandages, and apply from six to a dozen leeches to the neighbourhood of the wound. He must also substitute for the cold lotion the use of fomentations, and enemolent poultices, under which is to be laid over the orifice of the wound a small pledget ofispermaceti, or other simple ointment. The poultices and fomentations are to be renewed morning and evening, and the leeches may be repeated, if necessary, three or four times.

By pursuing this antiphlogistic fort of treatment, suppuration may be sometimes entirely prevented, and the formation of large deep abscesses frequently averted. Should extensive collections of matter, however, take place, proper openings are to be then made without delay, either by dilating the original wound, or by making one or more incisions in other places, as may seem most advantageous. The case, in fact, is then to be treated upon the very same principles which are observed in the management of abscesses in general.

Of contused and lacerated Wounds.—The impressions which have the effect of producing what is termed a contusion, are either of an ordinary description, such as a cudgel, a stone, &c. or they consist of balls, bullets, and other metallic bodies, which are impelled into the flesh with immense velocity by the explosion of gunpowder. The latter occasion particular kinds of injury, well known by the name of gun-shot wounds, which are a class of cases so highly interesting, that although they are critically only examples of severely contused wounds, surgeons have always found it expedient to treat them as distinct and peculiar cases. Indeed, when it is recollected how many difficult, intricate, and momentous questions the subject of gun-shot wounds embraces, the necessity of considering it by itself is immediately manifest.

The blunt weapons, or obuse hard substances, which, being applied with violence to any part of the living body, bruise, rupture, and otherwise hurt the fibres and vessels, may produce two different species of injury. First, they may more or less forcibly compress and crush the parts upon
Contused and lacerated wounds not only differ from incised wounds in the circumstance of their being more disposed to suppurate, and more difficult to heal by the first intention, they differ also in the particularity of not bleeding much, sometimes even when the largest arteries are lacerated, as must be the case when whole limbs are torn away, in consequence of becoming entangled in different kinds of machinery.

This indisposition to hemorrhage is not altogether a favourable omen, because though the patient runs less chance of bleeding to death in these cases than in cut wounds, yet the very circumstance of the large vessels not pouring out blood evinces that the violence, contusion, and other injury done to the parts, in addition to the mere division of them, must have been excessively severe, and that the dangers of the subsequent inflammation, suppuration, and sloughing of the parts, more than counterbalance the present security from bleeding.

We shall not find, in all the records of surgery, any facts more extraordinary than those which have been published at different periods on the subject of whole limbs being torn away, not only without hemorrhage, but without any other fatal effects. The cases of limbs torn off related by Chefelden, in the Philosophical Transactions, by La Motte, in his Traité des Accouchements, by Mr. Carmichael, in the fifth volume of the Edinb. Med. Commentaries, and others in the second volume of the Mém. de l'Acad. de Chirurgie, are some of the most remarkable.

As far as our observations extend, all lacerated and contused wounds should be treated according to common anti-phlogistic principles. When the injury is extensive, and attended with a great deal of contusion, venefication is to be practiced, and the oozing of blood from the surface of the wound may be encouraged by the use of fomentations. With respect to dressings, they should always be of a mild unirritating quality. After leeching, by a flrip or two of adhesive plaster, the exposed cavity of the wound, when it is large and the surrounding skin loose, the part may be covered with pledgets of the ungumentum cerer, over which should be laid an emollient poultice. As the first dressings should not be removed for at least 24 or 36 hours, care ought to be taken to put into the poultice a sufficient quantity of sweet oil, to prevent it from becoming soon hard. Afterwards, however, the dressings may be changed once, twice, and even thrice a day, in bad cases, with advantage; for as soon as the sloughs begin to separate, and suppuration to take place, the necessity for changing the dressings and poultices more frequently is self-evident. In severe cases, fomentations may be used at the periods of dressing; and it will be found that nothing is so effectual in relieving the pain arising from the inflammation which has been induced. The employment of leeches also should not be forgotten, as a valuable means of palliating the inflammatory symptoms. Professed Alfani, of Milan, has lately written strongly in praise of the good effects which are produced by the application of cold washes to parts which have received contused wounds (see his Manuale di Chirurgia); and we believe the plan is particularly useful in the first instance, when it is a great object to check the increase of extravasated fluids in the surrounding parts. But afterwards we think emollient applications are the best; and, indeed, it may be questioned, whether the employment of cold lotions at first would not sometimes be objectionable, inasmuch as they must tend to stop the oozing of blood from the surface of the wound; a thing which is considered by many surgeons extremely beneficial, and an object which they think ought to be promoted even by the use of fomentations.
WOUNDS.

This is a point, however, which comparative and unprejudiced experience is alone capable of deciding. If, in cases of lacerated and contused wounds, the surgeon is led frequently, than in incised wounds, called upon to take measures for stopping bleeding immediately after the accident, he finds greater occasion for attending to another important duty, imposed upon him in his professional attendance upon wounded persons in general: we allude to the early removal of all foreign bodies and extraneous substances from the wound. Cuts are usually made with clean sharp instruments; but contused and lacerated wounds often occur in a manner which renders them particularly likely to contain dirt, gravel, bits of glass, porcelain, &c. We have seen one case in which the patient could not use his arm for a twelvemonth, in consequence of some fragments of a broken bottle not having been taken out of a wound of the hand in the first instance. The wound did indeed heal up; but the pieces of glass occasioned so much pain and inconvenience, that the part could not be used. New incisions were unsuccessfully made for their removal, and the fingers were becoming permanently bent and contracted when we left the patient. Whether the foreign bodies have been habitually extracted we know not; but the case deeply impressed us with the importance of always removing extraneous substances while a wound is fresh, and before admits of the requisite examination.

With regard to lacerated wounds, the same practical remarks apply to them which have been offered on the subject of contused wounds; but the prognosis is generally considered as more unfavourable, and in warm climates tetanus is alleged to be a very frequent consequence of these injuries. See Tetanus.

The bites of rabid animals afford examples of a most dangerous description of lacerated and contused wounds, the peril, however, originating not from the mechanical injury itself, but from the case being complicated with the infection into the wounded part of a poison or virus, the effects of which, when they do occur, almost bid defiance to the power of the medical art. See Hydrophobia.

As soon as the surface of a contused or lacerated wound has thrown off its flouffes, suppurated, became clean, and evinced a tendency to form granulations, the poultices are to be discontinued, and simple dressings employed. These are afterwards to have their quality altered, according to the appearances which the sore may assume; but any further directions respecting the management of the case, after it has arrived at this stage, must be quite superfluous here, as ample instructions will be found in the article Ulcer.

Some contused and lacerated wounds would inevitably be followed by the rapid mortification of the limb, and the patient run the greatest risk of losing his life, were amputation not to be performed immediately after the receipt of the injury. These are generally examples in which the soft parts are extensively and deeply wounded, and large blood-vessels and nerves also injured. The size, however, of the wound seems of itself sometimes to be a cause of gangrene; for we remember a brewer's servant, who, when fitting on the fore-part of a dray-cart, met with an injury, by which the skin covering the front of the tibia was torn from the knee to the ankle, and though no other mischief appeared to have been received, the whole limb and even the scrotum rapidly mortified, and the man lost his life. It should be known, that these are cases of what M. Larrey calls traumatic gangrene, in which he and some other modern surgeons conceive that amputation may often be done with success, though the mortification has not ceased to spread at the time of the operation. (See Surgery.) This practice had also its advocates in former days; but since the time of Mr. S. Sharp and Mr. Pot, the rule of never attempting amputation before a line of separation has formed between the dead and living parts, has been acknowledged, taught, and respected, in every school of surgery.

For an account of the treatment of contused and lacerated wounds which have ended in mortification, the reader must turn to the article Gangrene.

Of Gun-shot Wounds.—Strictly these cases ought, perhaps, to be claffed with other wounds, attended with much contusion and laceration of the parts; but the injuries which are received in modern warfare from the employment of fire-arms are so numerous, complicated, and various, that the subject undoubtedly merits separate consideration.

A general description of these accidents, and of the method of treatment, will be found under the head of Gun-shot Wounds. Since that article was written, however, so much valuable information has been laid before the public by several distinguished army and navy surgeons, that it becomes necessary for us to avail ourselves of the present opportunity to notice some practical points of the first-rate importance in military surgery.

Amongst the observations on the subject of Gun-shot Wounds in a former volume, the reader will find a statement of some of the sentiments which were entertained by the late Mr. Hunter concerning the treatment of these injuries. It will there be found, that this celebrated surgeon, as well as a few other eminent practitioners, was far from being an advocate for immediate amputation, even in cases in which he acknowledged that there was no possibility of ultimately saving the injured limb. It was his opinion, that more patients died when the operation was done early, than when it was performed in a later stage, after inflammation had subsided, and suppuration had been fairly established. Such precepts, however, do not coincide with the results of modern experience; and, as in numerous instances, the decision for amputation or for delay involves the question of life or death, we think that every opportunity ought to be taken of refuting this part of Mr. Hunter's writings.

According to the united observations of all well-informed experienced army surgeons, it may now be set down as an established rule in military surgery, that in every case in which a limb is so shattered and injured, that no probability of its being finally saved presents itself, amputation ought to be done at once, without any delay. For nearly the last two hundred years, there have always been some men of talents and experience, who not only recommended, but actually adopted this judicious practice. Du Chefne, who wrote in 1625, advises the performance of amputation in cases of severe injuries of the limbs; and it is worthy of remark, that he directs the operation to be performed before inflammation and other constitutional symptoms have supervened. (See Traité de la Cuir gériale et particuliere des Archefufes, Paris, 1625, p. 143.) Wiseman, the father of English surgery, not only recommended and practised immediate amputation, but the same thing was not unfrequently done by the military surgeons of his time. (Chirurgical Treties by R. Wiseman, 3d edit. London, 1696, p. 410.) The celebrated Le Dru, in his excellent little manual of military surgery, declared himself an advocate for immediate amputation in all cases in which that operation from the first appears to be indispensible. (See Traité ou Reflexions tirées de la Pratique fur les Plaies d'Armes à feu, Paris, 1737.) Ranby, who was serjeant-surgeon to king George II, entertained opinions similar to those of Le Dru, with regard to
WOUNDS.

to the advantages and necessity of immediate amputation, whenever the injury is such as to remove all reasonable hope of ultimately saving the limb. See Ranby's Method of treating Gun-shot Wounds, edit. 5. p. 29. London, 1781.

The following account of this interesting subject is principally abstracted from the third edition of Cooper's Dictionary of Practical Surgery, published in the year 1818:—

After the battle of Fontenoy, in the year 1756, the Royal Academy of Surgery in France offered a prize for the best dissertation on the gun-shot injuries requiring immediate amputation, and on other cases of the same nature, where the operation, though deemed inevitable, might be delayed. The prize was adjudged to the dissertation of M. Faure, the main object of whose paper was to recommend delaying the operation. The tide of the question espoused by M. Faure has found some modern advocates of distinguished talents and celebrity. Suffice it to mention the names of Hunter, Baron Percy, and Lombard. It is, however, only justice to M. Faure to state in this place, that though he regarded immediate amputation as full of danger, he admitted that there were several kinds of injuries of the extremities in which it was indisputably and immediately required. "The enumeration," says Dr. Thomson, "which this author has given of these injuries is more full and distinct than any which had been published before his time; and, what may appear singular, it does not differ in any essential respect from the enumerations given by later writers, who, in combating his opinions, have represented him as an enemy to amputation in almost all injuries of the extremities." See Report of Observations made in the Military Hospitals in Belgium, p. 169.

Although in France the academy of surgery thought proper to decree the prize to M. Faure, whose doctrine thus received the highest approbation, yet in that country very opposite tenets were set up by some men of distinguished talents and extensive military practice. Thus de L'Ean, consulting surgeon to the French army, in his work on gun-shot wounds, published in 1737, expressly states, "that when the amputation of a limb is indispensably necessary in the case of a gun-shot wound, it ought to be done without delay." (Aphorism 9.) M. La Martiniere, in particular, wrote some excellent arguments in reply to M. Bilguer; arguments which would do honour to the most accomplished surgeon of the age in which we live. (See Memoire sur le traitement des plaies d'armes à feu, in Mem. de l'Acad. de Chirurgie, tom. xi. p. 1. edit. in 12mo.) M. Boucher, of Lille, was an advocate for the same side of the question. (See Ob. sur des plaies d'armes à feu, &c. in Mem. de l'Acad. de Chirurgie, tom. v. p. 279, &c. edit. in 12mo.) Schmucker, who was many years surgeon-general to the Prussian armies, published in 1776 an essay on amputation, in which he particularly mentions, that during his stay at Paris in 1738, the surgeons of the Hotel-Dieu had been in the habit of performing immediate amputation in severe injuries of the extremities. He also declares himself an advocate for operating immediately, in all cases in which amputation from the first appears to be necessary, and inflicts, in a particular manner, on the increased danger which he had seen arise from the operation during the second period. He gives, as Dr. J. Thomson has observed, a minute and circumstantial enumeration of those injuries, both of the upper and lower extremities, in which he conceived amputation to be necessary, and in many of which he had actually performed it with great success. Schmucker appears to Dr. Thomson to have given a better account than any preceding military surgeon of the injuries of the thigh; and from the results of his experience, he was led to believe, that though compound fractures of the lower part of the thigh-bone might, in favourable circumstances, be cured without amputation, yet that this operation is peculiarly necessary in all cases in which the fracture is situated in or above the middle of that bone. (See Unteruchung über die Abnebmmung der Glieder von J. L. Schmucker. Vermischte Chirurgische Schriften, band i. Berlin, 1785.) With the foregoing high authority we have to join one of not less celebrity, namely, that of M. Larrey, who has proved most convincingly, that when amputation is to be done in cases of gun-shot wounds, nothing is so pernicious as delay. See Memoires de Chirurgie Militaire, tom. ii. p. 451, &c.

The principles inculcated by M. Larrey are, in point of fact, the same as those which were so floridly inculcated upon by Mr. Pott, in his remarks on amputation. Mr. Pott, indeed, was not an army surgeon, and what he says was not particularly designed to apply to military practice, but he has represented, as well as any body can do, the propriety of immediate amputation for injuries, which leave no doubt that such operation cannot be deplored with.

Mr. John Bell, amongst the moderns, also defended the propriety of early amputation, long before the sentiments of later writers were ever heard of. He distinctly states, that "amputation should, in those cases where the limb is plainly and irrecoverably disordered, be performed upon the spot." (See Difcources on the Nature, &c. of Wounds, p. 488. edit. 3.) Indeed, notwithstanding all the modern pretensions to novelty upon this interesting topic, we must acknowledge, with Dr. Thomson, that the evidence in favour of the advantages of immediate amputation has always preponderated over that for delay. See Report of Obs. made in the Military Hospitals in Belgium, p. 225.

The strongest body of evidence upon this matter, however, is adduced by M. Larrey, whose situation at the head of the medical department of the French army has afforded him most numerous opportunities of judging from actual experience.

"If we are to be told," says he, "that the amputation of a limb is a cruel operation, dangerous in its consequences, and always grievous for the patient, who is thereby mutilated; that, consequently, there is more honour in falling a limb, than in cutting it off with dexterity and success; these arguments may be refuted by answering, that amputation is an operation of necessity, which offers a chance of preservation to the unfortunate, whose death appears certain under any other treatment; and that if any doubt should exist of amputation being absolutely indispensable to the patient's safety, the operation is to be deferred, till nature has declared herself and given a positive indication for it. We are also justified in adding, that this chance of preservation is at the present day much greater than at the epoch of the academy of surgery. We learn from M. Faure, that of about three hundred amputations performed after the battle of Fontenoy, only thirty were followed by success, whilst, on the contrary, says M. Larrey, we have saved more than three-fourths of the patients on whom amputation has been done, and some of whom also had two limbs removed. This improvement is ascribed by M. Larrey, 1st, to our now knowing better how to take advantage of the indication and favourable time for amputating; 2dly, to the dressings being more methodical; 3dly, to the mode of operating being more simple, less painful, and more expeditious, than that formerly in vogue."

To the preceding authorities against delaying amputation, in cases of gun-shot wounds requiring such operation, we have to add that of Mr. Guthrie, deputy inspector of mili-
tary hospitals, whose opportunities of observation, during the late war in Spain, were particularly extensive. Mr. Guthrie, however, does not recommend amputation to be done immediately, if the patient be particularly depressed by the shock of the injury directly after its receipt. "If a soldier, at the end of two, four, or fix hours after the injury, has recovered from the general constitutional alarm occasioned by the blow, his pulse becomes regular and good, his respiration easy, he is less agitated, his countenance revives, and he begins to feel pain, discomfits, and uneasiness in the part: he will now undergo the operation with the greatest advantage, and if he bears it well, of which there will be little doubt, he will recover in the proportion of nine cases out of ten, in any operation on the upper extremity, or below the middle of the thigh, &c. If, on the contrary, the operation be performed before the constitution has recovered itself, to a certain degree, from the alarm it has sustained, the additional injury will most probably be more than he can bear, and he will gradually sink under it and die." (On Gun-shot Wounds, p. 24. London, 1815.) As far as our experience goes, however, all delay is improper when the necessity of amputation is undoubted, at least all delay beyond the short period, during which the faintness immediately arising from the injury usually lasts. In the campaign in Holland, in 1814, the most successful amputations were those done in the field hospitals directly after the arrival of the patients. On this point, however, hardly any difference of sentiment prevails, because all naval and military surgeons agree, and mean, that amputation is not to be performed till the faintness and depression of the powers of life, directly following the wound, have been sufficiently obviated for the patient to bear the operation well. The seeming difference, therefore, on this matter, between Mr. Guthrie and Mr. Hutchison, is not very material. (See Hutchison’s Practical Obst. on Surgery, 1817.) It appears from some returns, collected by Mr. Guthrie, that in the peninsula, the comparative loss, in secondary or delayed operations, and in primary or immediate amputations, was as follow: —

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<th>Upper extremities</th>
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<th>Primary.</th>
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<td>Lower extremities</td>
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The great success attending operation on the field of battle was also convincingly proved after the battle of Touloufe. Here of 47 immediate amputations, 38 were cured, while of the 51 delayed operations, on that occasion, 21 had fatal terminations. P. 42—44.

Lastly, we have to notice, amongst the advocates for immediate amputation, Mr. Hennem, a surgeon employed with our army in Spain and the Netherlands. “The question,” says he, “of immediate amputation has of late attracted an attention, which its great importance naturally calls forth; but it appears to me, that an idea has been impressed upon the minds of practitioners in civil life, that doubts as to the propriety of the practice had existed among the British army surgeons. For my own part, I have never known any differences of opinion on the point. In books, it is true, it has been most amply discussed before the present generation were in exilence; but in British practice all doubts have long been at an end. It is but justice to British surgeons, both naval and military, to declare, that immediate amputation is neither a new doctrine nor a recent practice among them, &c.” See Hennem’s Obst. on some important Points in the Practice of Military Surgery, p. 45. Edinb. 1818.

Hence, however, military surgeons have definitively settled the great question, that in all cases in which a limb cannot be saved, the sooner amputation is done the better, they neither have, nor probably will ever be able positively to settle and define the exact degree of injury which, in every instance, ought to be followed by putting the former rule in practice. In fact, no part of surgery is more difficult, than that in which the question of the possibility or imposibility of saving wounded limbs is submitted to the judgment and determination of the practitioner. Some injuries, indeed, are so bad, that no difficulty in making a decision is experienced; but there are other cases, in which the damage done to the parts is less violent and extensive, and in which the exact degree of mischief is not at first apparent. There are, in short, numerous doubtful examples, in which the formation of a right judgment is equally difficult and important.

The annexed remarks will convey the sentiments of some of the latest writers on the second great question in military surgery. What are the exact cases in which amputation should be done immediately, and what are those in which the operation may be deferred?

**Of Cases in which Amputation should be done immediately.**

First cafe. A limb carried away by a cannon-ball, or the explosion of a howitzer, or bomb, requires amputation without any loss of time: the least delay puts the patient’s life in danger.

In this case, the necessity of the practice is inculcated by M. Larrey himself, as well as by Schnucker, Richter, Larrey, Dr. Thomson, and every modern writer upon gun-shot wounds.

If the operation be not speedily done, pain commences, fever occurs, and the functions become disordered; the irritation then increases, and convulsive motions take place.

If the patient should not be a victim to these first symptoms (continues Larrey), gangrene of the stump is occasioned, the fatal consequences of which it is extremely difficult to prevent.

Second cafe. When a body propelled by gunpowder strikes a limb, in such a manner as to smash the bones, violently contuse, lacerate, and deeply tear away the soft parts, amputation ought to be immediately performed. If this measure be neglected, all the injured parts will soon be feized with gangrene: and besides, as M. Larrey has explained, the accidents which the gravity of the first case produces will also be here excited. It is only doing justice to the memory of M. Faure to state, that this second case was one which he also particularly influenced as demanding the immediate performance of amputation. See Prix de l’Acad. Royale de Chirurgie, tom. viii. p. 23. edit. 12mo.

Third case. If a similar body were to carry away a great mass of the soft parts, and the principal vessels of a limb (of the thigh for instance), without fracturing the bone, the patient would be in a state demanding immediate amputation; for, independently of the accidents which would originate from a considerable loss of substance, the limb must inevitably mortify. M. Guthrie also says, “a cannon-shot destroying the artery and vein on the ischio-femoral (of the thigh), without injuring the bone, requires amputation.” (P. 185.) When, however, the femoral artery or vein is injured by a musket-ball, or small cannon-shot, this gentleman recommends tying the vessel above and below the wound in it, if the nature of the case be evinced by hemorrhage. But he believes, that when both vein and artery are injured, amputation is necessary. (P. 186.) An injury of the femoral artery, observes Mr. Guthrie, requiring an operation, and accompanied with fracture of the bone of the most simple kind, is a proper case for immediate amputation;
WOUNDS.

for although many patients would recover from either accident alone, none would surmount the two united, and the higher the accident is in the thigh, the more imperative is the necessity for amputation.

Fourth case. A large biseacyen strikes the thick part of a member, breaks the bone, divides and tears the muscles, and destroys the large nerves, without, however, touching the main artery. According to M. Larrey, this is a fourth case requiring immediate amputation.

Mr. Guthrie also says, that “if a cannon-shot strike the back part of the thigh, and carry away the muscular part behind, and with it the great sciatic nerve, amputation is necessary, even if the bone be untouched, &c. In this case, I would not perform the operation by the circular incision, but would prefer a flap from the fore part or sides, as I could get it, to cover the bone which should be short.” Guthrie on Gun-shot Wounds of the Extremities, p. 184.

Fifth case. If a spent cannon-shot, or one that has been reflected, should strike a member obliquely, without producing a solution of continuity in the skin, as often happens, the parts which reft its action, such as the bones, muscles, tendons, aponeuroses, and vessels, may be ruptured and lacerated. The extent of the internal disorder is to be examined; and if the bones should feel through the soft parts as if they were smashed, and if there should be reason to suspect from the swelling, and a sort of fluctuation, that the vessels are lacerated, amputation ought to be immediately practised. We learn from M. Larrey, that this is also the advice of M. Percy, an eminent French army surgeon.

Sometimes, however, the vessels and bones have escaped injury, and the muscles are almost the only parts disordered. In this circumstance, we are enjoined to follow the council of M. La Martiniere, who recommended making an incision through the skin. By this means, a quantity of thick blackish blood will be discharged, and the practitioner must await events. According to M. Larrey, such incision is equally necessary in the preceding case before amputation, in order to ascertain the extent of the mischief which the parts have sustained.

It is to such injury done to internal organs, that we must ascribe the death of many individuals, which was for a long time attributed to the commotion produced by the air put in motion by the ball, when this, in grazing upon different parts of the body, alters them, or cuts off the column of air which is to serve for respiration, just at the moment when it is about to enter the chest. See Ravaton’s Traité des Plaies d’Armes à Feu.

But to return to the object of our present consideration. M. Larrey expresses his belief, that what have been erroneously termed wind contusions, if they are attended with the mischief above specified, require immediate amputation.

The leaf delay makes the patient’s preservation extremely doubtful. The internal injury of the member may be ascertained by the touch, by the loss of motion, by the little sensibility retained by the parts which have been struck, and, lastly, by practice an incision, as already recommended.

Sixth case. When the articular heads are much broken, especially those which form the joints of the foot or knee, and the ligaments, which strengthen these articulations, are broken and lacerated by the fire of a howitzer or by a biseacyen, or other kind of ball, immediate amputation, says M. Larrey, is indispensible. According to this experienced writer, the same indication would occur, were the ball lodged in the thickness of the articular head of a bone, or were it so engaged in the joint as not to admit of being extracted by simple and ordinary means. (See also Guthrie on Gun-shot Wounds, p. 197.) Putting out of consideration cases in which the injury has been done by a clean cutting instrument, or in which a small ball has passed near or partially injured a joint, another experienced army surgeon also lays it down as a law in military surgery, that no lacerated joint, particularly the knee, ankle, or elbow, should ever leave the field unamputated, where the patient is not obviously sinking, and consequently where certain death would follow the operation. (Hennens Military Surgery, p. 42. ) And in another place he tells us: “In my own practice, I have met with only two cases, where the limb was saved after a serious injury of the knee-joint; and in one of them only was the perfect use of it restored. I never met with an instance where the ankle or elbow-joint was perfectly restored after severe injury, though some where the limb has been saved. Of the shoulder-joint the recoveries are more frequent.” P. 159.

Fractures extending into the joints, and accompanied with great laceration of the ligaments, were cases of gun-shot injuries pointed out by M. Faure as indispensible requiring immediate amputation. (See Prix de l’Acad. de Chr. tom. viii.) Thus we see, that this author was not so averse to early amputation as several modern writers have represented.

It is only in this manner, that the patients can be rescued from the dreadful pain, the spasmodic affections, the violent convulsions, the acute fever, the confiderable tenion, and the general inflammation of the limb, which, M. Larrey observes, are the invariable consequences of bad fractures of the large joints. But, adds this author, if the voice of experience be not listened to, and amputation be deferred, the parts become disorganized, and the patient’s life is put into imminent peril.

It is evident, says he, that, in this case, if we wish to prevent the patient from dying of the conseqent accidents, amputation should be performed before twelve or at most twenty-four hours have elapsed: even M. Faure himself professed this opinion, in regard to certain descriptions of injury. Mém. de Chr. Militaire, tom. ii.

With respect to wounds of the knee, the sentiments of Mr. Guthrie nearly coincide with thofe of M. Larrey. “I most solemnly protest (says Mr. G.) I do not remember a cafe do well, in which I knew the articulating end of the femur, or tibia, to be fractured by a ball that passed through the joint, although I have tried great numbers, even to the last battle of Toulouf. I know that perfons wounded in this way have lived; for a recovery it cannot be called, where the limb is useless, bent backward, and a constant source of irritation and dilfrefs, after several months of acute suffering, to obtain even this partial security from impending death; but if one cafe of recovery should take place in fifty, is it any fort of equivalent for the sacrifice of the other forty-nine? Or is the preferring of a limb of this kind an equivalent for the loss of one man?” On Gun-shot Wounds, p. 196.

Mr. Guthrie admits, that fractures of the patella, without injury of the other bones, admit of delay, provided the bone is not much splintered.

Seventh case. According to M. Larrey, if a large biseacyen, a small cannon-shot, or a piece of a bomb-shell, in palling through the substance of a member, should have extensively denudè the bone, without breaking it, amputation is equally indicated, although the soft parts may not appear to have particularly suffered. Indeed, the violent concussion produced by the accident has shaken and disorganized all the parts; the medullary substance is injured, the vessels

Vol. XXXVIII.
amputate above this joint, the less important wound need not be dried till after the operation, provided it can be comprehended in the section of the member, or be so near the place of the incision as to alter the indication. When the wound demanding amputation is the upper one, the operation of course is to be done above it, without paying any regard to the injury situated lower down.

M. Larrey, however, approves of deferring the operation, when delirium, convulsions, and inflammation, prevail on the first receipt of the injury. In this circumstance, we are advised to take measures for appeasing these accidents; the progres of nature is to be carefully observed; and the first moment of quiet is to be taken advantage of for the performance of the operation. See Larrey's Mém. de Chirurgie Militaire, tom. ii. p. 451, &c.

Ninth cafe. To the foregoing species of gun-shot wounds, pointed out by M. Larrey as urgently requiring immediate amputation, are to be added compound fractures of the thigh from gun-shot violence.

"Gun-shot fractures of the thigh," says Dr. J. Thomson, "have been universally allowed to be attended with a high degree of danger; indeed, till of late years, very few instances have been recorded of recovery from these injuries. Ravon acknowledges, that in his long and extensive experience, he had never seen an example of recovery from a gun-shot fracture of the thigh; and Belguer, in his calculations with regard to those who recover from gun-shot fractures, sets aside those of the thigh-bone, as being of a nature altogether hopeless. In the present improved state of military surgery, instances not unfrequently occur of recovery from this fracture; but of these, the number will be found, I believe, to be exceedingly small, in comparison with those who die, particularly when the fracture has had its seat above the middle of the bone, &c."

According to the observation of Percy, scarcely two of ten recover of those who have suffered gun-shot fractures of the thigh-bone. Mr. Guthrie says, that "upon a review of the many cases which I have seen, I do not believe that more than one-sixth recovered so as to have useful limbs; two-thirds of the whole died either with or without amputation; and the limbs of the remaining sixth were not only nearly useless, but a cause of much uneasiness to them for the remainder of their lives." See Guthrie on Gun-shot Wounds, p. 191.

"In fractures by musket-bullets of the lower part of the thigh-bone (says Dr. Thomson), recovery not unfrequently takes place; and both Schmucker and Mr. Guthrie conceive, that they are injuries in which amputation may be delayed with safety. It would be very agreeable, that this opinion should be confirmed by future experience; but it appears to me, that before it can be received as a maxim in military surgery, much more extensive and accurate observation than we yet possess will be required, with regard to the proportion of those who recover without amputation, or after secondary operations, and of those who recover after primary amputation. Of those who had suffered this injury, we find, comparatively, but a small number recovering in Belgium, and they had been attended with severe local and constitutional symptoms." See Report of Observations made in the Military Hospitals in Belgium, p. 247, et seq.

Balls often produce lacerations of several inches in length in the thigh-bone. This is a state, observes Dr. Thomson, which must be very unfavourable to recovery; and his conclusion is, that in general, even in fractures of the lower part of the thigh-bone, a greater number of lives will be preferred in military practice by immediate amputation, than
than by attempting the cure without that operation. "When the bone appears, on a careful examination, to be broken without being much splintered, and when the patient can be removed easily to a place of rest and safety, it may be right to attempt to preserve the limb; but if the bone be much splintered, or if the conveyance is to be long or uncertain, I will, in most instances, I am convinced, be a much safer practice, even in fractures of this part of the thigh-bone, to amputate without delay.

"Muleket-bullets, in passing through the femur, near to the knee-joint, produce fissures of the condyles, which generally communicate with the joint. These cases, like those in which the bullets have passed directly through the joint, require immediate amputation.

"The writings of military surgeons contain but few histories of cases in which the thigh-bone had been fractured above its middle by the passage of muleket-bullets. These are cases, I believe, which have generally had a fatal termination; and the danger attendant upon the amputation which they require, seems long to have deterred surgeons from attempting to ascertain what advantages might be derived from the employment of that operation. Schmucker recommends and states, that he had practised with success immediate amputation in those cases, in which a sufficient space was left below the groin for the application of the tourniquet. It is curious to remark, in the history of amputation, how long surgeons were in discovering the case and safety with which the femoral artery may be compressed by the fingers, or padi, in its passage over the brim of the pelvis. But, from the immediate danger, protracted suffering, and ultimate want of success, which he had observed to be likely to occur, it is impossible to determine a priori those which will require the operation subsequently. One gun-shot wound, for example, will be cured by ordinary treatment, while another, that is at first less severe, will afterwears render amputation indispensible, whether this be owing to the patient's bad constitution, or the febrile complaints which are induced. However this may be, the safe rule for ascertaining the indication that presents itself, is to amputate consecutively only in circumstances in which every endeavour to save the limb is manifestly in vain. Upon this point, M. Larrey's doctrine differs from that of M. Faure.

The latter practitioner admits cases, which he terms cases of the second kind, in which he delays amputation, not with any hope of saving the limb, but in order to let the first symptoms subside. The operation done between the fifteenth and twentieth day, appears to him less dangerous than when performed immediately after the receipt of the injury. At the above period, according to M. Faure, the commotion occasioned by the gun-shot injury is dispersed; the patient can reconcile himself to amputation, the mere mention of which fills the pusillanimous with terror in a greater or less degree; the debility of the individual is no objection; and it is laid down as an axiom, 'that the consequences of every amputation, done in the first instance, are in general extremely dangerous.' In support of this theory, M. Faure addsuces ten cases of gun-shot injuries, in which, after the battle of Fontenoy, the operation was delayed, in order that it might afterwards be performed with more success; a plan which, according to the author, proved completely successful. See Prix de l'Acad. de Chirurgie, tom. viii. edit. in 12mo.

This division of the cases for amputation into two classes, not confounded with nature, observes M. Larrey, has been the cause of a great deal of harm. Very often the partisans of M. Faure have not dared to report in the first instance to amputation, the dangers of which they exaggerate; while, on other occasions, they amputate consecutively, without any success.

The effects of commotion, instead of increasing, gradually diminish and disappear after the operation. It is proved, says he, that the commotion, so far from being a counter-indication to immediate amputation, is a reason that should incline the surgeon to operate. Such was the sentiment of La Martiniere and Boucher.

Neither ought the patient's alarm to be a reason for postponing the operation; for according to M. Larrey, the patient jilt after the accident will be much less afraid of the risk which he has to encounter, than after the expiration of the first four-and-twenty hours, when he has had time to reflect upon the consequences of the injury, or of amputation. This remark has been made by the illustrious Paré.
How contrary this advice to that inculcated by Sharp, Pott, and nearly all eminent surgeons of the present time!

A particular case of gangrene has been pointed out by Mr. Guthrie as demanding the early performance of amputation, and a deviation from the old rule of waiting till the mortification has spread. It is when gangrene occurs after wounds of the large blood-vessels of a limb. See Guthrie on Gun-shot Wounds of the Extremities, p. 63, &c.

Second case. Convulsions of the wounded Limb.—Amputation of the member, performed immediately after the first symptoms of tetanus manifest themselves, more especially those of chronic tetanus, was proposed and even practised by Larrey with partial success. He supposed, that all communication between the original injury, and the rest of the body being thus cut off, the general disorder might cease.

Third case. Bad State of the Discharge.—It often happens, that in gun-shot wounds, complicated with fractures, notwithstanding the most skilful treatment, the discharge becomes of a bad quality; the fragments of bone lie surrounded with the matter, and have not the least tendency to unite; the patient is attacked with hectic fever, and a colliquative diarrhoea. Under these circumstances, life may sometimes be preserved by amputation.

Fourth case. Bad State of the Stump.—In hospitals, says M. Larrey, the cure of amputations is sometimes prevented by a fever of a bad character. The tumefaction, the integuments become at first retracted, and then reverted and discharged a good way upward. The wound changes into a fungous ulcer, the cicatrization of which is hindered by the deep disfigurement of the bone, and the ulceration of the soft parts. The extremity of the bone projects. In order to remedy this evil, it has been proposed to saw off the projecting part of the bone, and with this even to amputate all the flesh beyond the level of the skin. M. Larrey condemns such practice, as unnecessary and dangerous, and he recommends giving nature time to effect the extirpation of the disfigured projecting part of the bone, and heal the wound.

WOUNDS.

Of poisoned Wounds.—These injuries are essentially different from all other description of wound, their great particularity depending upon the introduction of a venemous matter into the wounded parts, or its deposition upon the surface of the injury; and, in general, the poison is injected by the weapon with which the solution of continuity is produced. Sometimes, however, the contrary happens, when previous cuts, or scratches of the fingers, which are not healed, become infected with a virus, in the dissection of bodies, or in the dressing of venereal ulcers. Nay, there has lately been recorded in the public papers a remarkable instance, in which a nobleman’s servant died, as is alleged, from the effects of the poison of a toplid viper, the fangs and poisoned apparatus of which he had been handling and exhibiting to some visitors, at a time when he happened to have a flight cut upon one of his fingers. The case is extraordinary, not only on account of the way in which the infection was contracted, but also on account of the fatal event, which is very uncommon in animals of the magnitude of the human subject, as we shall hereafter notice.

Pricks with the point of a dressing-knife, when the instrument is covered with putrid, infectious, irritating matter, may be considered as a class of poisoned wounds. Sometimes, however, such accidents are followed by no injurious effects; and when the subject is strong and robust, a little inflamed tumour occurs in the situation of the puncture, the part feels, burrils, and then heals up. But, as Richerand observes,
WOUNDS.

observes, when the accident befalls a young man, who has been much weakened by hard study, any kind of excess, or some previous disease, it frequently happens that no local symptoms are seen. At the end of 24 or 36 hours, sometimes rather sooner, sometimes later, the axillary glands become affected with swelling, and a painful phlegmonous inflammation takes place in them. The wound afterwards seizes; the parts around it exhibit appearances of a flow of inflammation, and the conuent swelling of the hand is rather edematous than inflammatory. Next often succeeds nausea and proclivity to vomit, prostration of strength, a small accelerated pulse, and all the usual symptoms of typhus fever. Under these circumstances, if, instead of a tonic plan of treatment, which is strongly indicated, the evacuating method be adopted, the patient very soon falls a victim.

Experience fully proves, that in strong vigorous habits, nature refits with energy the introduction of poisons into the system.

In the cases under our consideration, tonic and cordial remedies are to be given in moderation. At the same time, care is to be taken to clear out the prime vire, when they appear to be disordered. Abroad, it is the common practice also to apply a grain of caustic potassa, or a drop of the liquid muriate of ammonia, to the little wound itself.

The stings of venomous insects, such as the bee, wasp, hornet, &c. are commonly treated with poisoned wounds. The pain of the injury is alleged to depend lefs upon the introduction of the sting, which sometimes breaks and is left behind, than upon the infection of a venomous fluid into the part. It is said, indeed, that the experiments made by professor Dufierl prove, that when the little cyll, situated at the base of the sting, is removed, the introduction of the sting itself into the flesh causes no particular pain. At the base of the sting there is a kind of vehicle, or referral, for containing the poisonous secretion, which is expelled and flows out along the sting, at the inflant when the latter penetrates the parts which are stung. The venom of the bee is stated to be neither of an acid nor of an alkaline nature.

When applied to mucous surfaces, and even to the cutaneous conjunctiva of the eye, it produces no disagreeable sensation; but if the point of a needle, after being dipped in it, be introduced into the flesh, a very acute pain is immediately excited. Various kinds of oil, honey, ammonia, spirit of wine, and several other reputed specifics, appear to deserve no such character, since they are found, after unprejudiced trials, to have no power of neutralizing the venom, nor of appeasing the actual pain arising from the sting.

When, therefore, a person has been stung by one or several bees, we are recommended to begin with extracing the stings, taking care, however, previously to cut off with a pair of scissors the little vehicle at their base containing the venomous secretion. This is to be done, left in the endeavours to remove the sting more of the venom should be extraced out of the little referral into the wound. The part is afterwards to be covered with snow, or bathed with ice-cold water, or some cooling fedative lotion. In short, the cafe is to be treated on common antiphlogistic principles, experience having fully proved that no specific has yet been discovered for the sting of the bee, and other venomous insects. For other opinions and observations on this subject, see the article Bee.

Bite of the Viper.—Of all the venomous reptiles which are met with in Europe, there are none which inflict so dangerous a bite as the viper or adder. Its upper jaw is furnished with two movable fangs, which are very sharp-pointed, grooved longitudinally, and at their root are connected with a vehicle which contains the venemous fluid. When the animal is irritated, the fangs become raised, and the poison flows along the grooves in them into the bitten part. The danger of the injury is in some measure proportioned to the fury of the animal; for when it is very much exasperated, it closes its jaws with greater force, and more of the venom is compressed into the wound. The degree of danger is also influenced considerably by the greater or less space of time that has elapsed since the reptile emptied the receptacles of its venom, by biting another person or animal. The injury likewise is generally found to produce lefs serious consequences, in proportion to the greater size of the animal which has been bitten. The experiments of Fontana prove, that the bite of a single viper will kill a mouse, a pigeon, or any other small animal; but that it must be the bites of several to kill a man, and of a still larger number to destroy an ox. It is also supposed by many writers on this subject, that in all animals, whatever may be their size, the degree of danger is considerably greater, if they should be much frightened on the occasion, the prostration of strength produced by fear being conjunctured to facilitate in a peculiar manner the pernicous operation of the venom. When a dog is bitten suddenly and unexpectedly, it is, oeteris paribus, much less hurt than when he has received the injury in a contest with the reptile, whose very aspect has more or lefs alarmed him. The bite of the viper is thought to prove generally more or lefs severe, in proportion to the heat of the weather.

The danger of the injury depends lefs upon the laceration of the parts, which, however, is considerable, than upon the kind of venomous inoculation with which it is attended. The symptoms which are excited come on almost immediately. The person who has received the bite suffers acute pain, and an inflammatory swelling spreads up the limb with remarkable rapidity, accompanied with a tendency to gangrene, as is indicated by the appearance of livid spots. Affections of the heart, attended with great weakness and vertigo, denote that the action of the poison extends to the whole system. But these general effects do not arise, as Fontana wrongly imagined, from the venom having a power of coagulating the blood in the vessels, but in all probability from its operation upon the nervous system.

The best plan of counteracting the beneful effects of the bite of the viper consists in introducing a few drops of the fluid muriate of antimony into the wound, and a small hair pencil may be used for the infliction of the cautic, if the punctures should happen to be deep. Indeed, when the bottom of the wound cannot be cauterized without dilating it, the latter step is deemed proper by the generality of surgical writers. The surrounding parts may be rubbed with a liniment composed of hartthorn and olive-oil; and cordial medicines are to be exhibited, especially ammonia.

The amputation of the bitten part is rather too frequent a mode of preventing the usual ill consequences of the bite of a viper to deserve recommendation. The ancients, with a view of counteracting the introduction of the poison into the body, were accustomed to apply a ligature round the limb above the injury; but it is a painful expedient, because it cannot hinder the absorption of the venom, and the general constitutional affection, unless the band be put on with sufficient tightness to impede the circulation. This, however, is the method which was adopted by Ambroise Paré, after he had been accidentally bitten by an adder.

The most important object in the treatment is the prompt application of remedies; for the introduction of the virus into
WOUNDS.

into the constitution ought to be prevented, if possible. This is more likely to be accomplished than any aim at neutralizing the venomous fluid, after its effects have extended to the whole animal economy. Even when the bite of a viper is entirely neglected, it very rarely proves fatal to the human subject. In many cases, the patients have recovered favourably under the mere use of olive-oil and of ammonia. These two medicines have been recommended as specifics both in the Transactions of the Royal Society, and by the celebrated Bernard de Jussieu; and amongst the cases in proof of their efficacy, authors still continue to quote the example of a dealer in vipers, who was quite indifferent about being bitten by these animals. He used to bath the part in olive-oil, and at the same time drink several ounces of this fluid. And in another instance, which is frequently cited, a student of botany, while herborizing, was bitten by a viper in a place where no medicine was at hand, except the eau de luce. Jussieu, who was present, introduced a few drops of this remedy into the wound, and administered a tea-spoonful of it internally in a glass of water. The eau de luce is nothing more than the liquor ammonia, containing a small quantity of the oleum fumici.

In France, and in other parts of the continent, the eau de luce is still looked upon as the internal medicine, on which most reliance can be placed.

In this country, arsenic, in strong doses, has been particularly recommended for its beneficial effects in counteracting the operation of the poison of snakes. The Tanjore pill, which has long been famous in India for its virtues in preventing the fatal symptoms arising from the bites of serpents in hot countries, was known to have arsenic as one of its ingredients. Mr. Ireland, an army surgeon, happened to be at St. Lucia, in the West Indies, when several men of the 62d regiment were bitten by the coluber carinatus of Linnaeus, the bite of which had already proved very fatal to several men of the same corps. Mr. Ireland immediately administered Fowler's solution of arsenic in strong doses, and the results of the cases, in which he had an opportunity of trying it, were highly favourable to the practice, as the men's lives were preserved by it. (See Medico-Chir. Trans. vol. ii. p. 393. &c.) Perhaps the prompt excision of the bitten part, or the free use of the actual cautery, should also be invariably put in practice, for the bites of the more deadly kinds of serpents, in conjunction with the exhibition of arsenic. But the ordinary consequences of the bite of a common adder are not serious enough to require so severe a proceeding as the excision or amputation of the parts would often be. Some observations on the structure of the viper will be found in the article COBBLER, and other remarks on the bite of this animal will be seen in the articles POISON and VIPER.

The work poisoned wounds ever met with in this climate are those produced by the bite of a mad dog, and other rabid animals; but for a particular account of this highly interesting subject, we must refer to HYDROPHOBIA.

Wounds of different Parts of the Face, Eye, Eye-lids, Ears, &c.—The countenance being the part in which any deformity is peculiarly conspicuous, it is always a great defideratum, in cases of wounds of the forehead, cheeks, nose, lips, &c. to prevent as much as possible the formation of ugly scars. Hence it is an invariable maxim to endeavour to heal wounds of the face by the first intention.

As cuts of the face can hardly be very deep, adhesive plaster is generally sufficient for holding their opposite edges together; but when the wound is situated in the lips, these parts are so incessantly in motion, that surgical find it best to maintain the sides of the division in contact by means of the twisted future, a description of which is given in the article HARLEPI.

When the edges of a wound of the lips are much contused and lacerated, some authors recommend them to be pared off, in order to increase the chance of union, and lessen the disfigurement of an uneven cicatrix.

Punctures of the transparent cornea of the eye are in themselves much less serious accidents than similar injuries of the sclerotic coat, which are almost unavoidably combined with a wound of the choroides and retina. Hence, the latter cases are frequently followed by a considerable degree of inflammation. Sometimes the crystalline lens itself is injured, and afterwards grows opaque.

Incisions made in the transparent cornea with very sharp instruments may not give rise to any serious consequences; and notwithstanding the escape of the aqueous humour, the crystalline lens and vitreous humour may remain in their natural situation. The form, thickness, and density of the cornea are circumstances which produce a spontaneous approximation of the edges of the wound to each other, and which, in fact, are extensively in contact. But the coaptation is rendered very exact, and a quick union much promoted, by drawing down the upper eye-lid, so as to flint the eye; in which state, the cartilaginous tarsus of the upper eye-lid makes an uniform compulsion on the cornea, in a manner which is extremely useful. Cuts of the felcerotica are not in general so simple. The choroides and retina may be at the same time either divided or exposed. In the first case, the expulsion of the whole of the vitreous humour, and a total disorganization of the eye, are to be apprehended from the immediate flatamatic contraction of the muscles of this organ; and, in the second, a violent and dangerous ophtalmia is to be expected. When, in the inhalence of a large wound of the felcerotica, choroides, and retina, the contents of the eye-ball are discharged, the organ inflames, and gradually shrinks into a much smaller mass, which is movable, and capable of supporting an artificial eye.

Contused wounds of the eye-ball are mostly followed by a destruction of the functions of the organ, either in consequence of the concussion of the retina, or of the inflammation to which these injuries usually give rise. However, in a few cases, even contused wounds of the eye have united very favourably, and without the loss of vision. Sometimes the solution of continuity extends through the felcerotica, while the conjunctiva itself is not ruptured. Delpech affirms, that he has seen several such cases, in which the latter membrane presented the appearance of an ecchymosis opposite the division of the felcerotica, and confined the humours of the eye, which otherwise would have been lost. Précis des Maladies Chir. tom. i. p. 349.

Nothing is more likely than gun-shot wounds to produce a violent concussion of the retina, and an invariable paralysis of this nervous expansion. The smallest particle of lead, which either strikes or penetrates the eye-ball, may occasion those effects. Every severe contusion of the eye may act in the same way. When the extravasation of blood originating from an accident of this kind is not attended with a serious concussion of the retina, the effused blood will be absorbed, and the functions of the eye restored.

In all cases of wounds of the eye, says M. Delpech, there are three fundamental indications: first, to prevent the expulsion of the vitreous humour and crystalline lens; secondly, to promote the quick reunion of the wound by placing its edges very accurately together; and thirdly, to do
WOUNDS.

do every thing in our power to avert inflammation. The two first objects cannot be fulfilled without keeping the eye-lids continually closed. The prompt re-union of the wound is one of the most effectual means of preventing inflammation; but when this affection cannot be entirely hindered, it is to be refitted by the kind of treatment which is explained in the article OPHTHALMY.

Wounds made with pointed instruments may pass through the eye-lids into the orbit, and thence through the thin bones which compose this cavity into the brain; or the weapon may penetrate directly between the eye-ball and side of the orbit into the brain. Injuries of this description generally prove fatal on the spot, though sometimes the patient lingered for a few hours.

In many instances, an injury by a ball, inflicted in the neighbourhood of one eye, produces paralysis of the other.

Pierre Rouffillier, of the 25th regiment of the line, in the service of Napoleon, (says Mr. Hennem,) was wounded on the 15th of June, at Waterloo. The ball entered the right eye; the left, though not in the slightest degree injured to appearance, was completely blind. ‘Tare, however, are the cases where death does not follow all wounds, particularly small punctured ones, going directly forward into the orbit, as this did. I felt under the zygoma, and all along the neighbourhood of this poor fellow’s wound; but in the puffy state of the parts could not detect the course of the ball. He himself was confident it had gone into his brain. He returned to France convalescent. Garengot (Traité des Opérations, vol. iii. obf. 29,) gives us an intereeting cafe from the lectures of Petit, in which a folder received a wound towards the great angle of the eye. It was deemed but of little consequence, and healed under the common hospital treatment. The man expressed a wish to leave the hospital, although cautioned by the surgeon, and had scarcely reached the door when he was seized with rigors, obliged to return, and died in two days. On dissection, the ball was found lodged under the sphenoid cells and hole of the optic nerve. The effect on this man’s sight is not mentioned.” Hennem’s Obf. on Military Surgery, p. 360.

Wounds of the lower part of the forehead, or eye-brow, are sometimes followed by the disorder named ptosis, in which the upper eye-lid hangs down more or less over the eye; but more commonly they give rise to an opposite complaint, called lagophthalmus, in which, from a contraction of the cicatrix, the skin is drawn up, and the upper eye-lid cannot be made to cover the eye. See these terms.

Wounds of the eye-brows sometimes caufe a species of blindness named the gutta serena. This congeuence is commonly thought to be owing to an injury of the nervous filament, which comes out of the orbit at the notch in the superciliary ridge. It is very probable, however, that the affection of the eye is not altogether dependent on the injury of the nerve; for the blindness very often occurs when the cut is not situated near the track of the nerve, and frequently does not occur when the nerve is known to be wounded. According to Richter, it is when the wound is nearly or quite healed that the event is most likely to happen.

Scarpa has fet down the gutta serena, arising from an injury of the supra-orbital nerve, as absolutely incurable; but we know that this statement is not altogether correct; for Mr. Hey has recorded in the Med. Obs. and Inquiries, vol. v. an example of amaurosis which got well, though it originated from a wound of the eye-brow. See GUTTA SERENA.

Mr. Hennem says, he has met with one or two cases of amaurosis from wounds of the supra-orbital nerve. The per-

fect division of the nerve did no good; but after some time the eye partially recovered. On Military Surgery, p. 366.

Wounds of the eye-lids scarcely admit of an effectual application of adhesive platter, and their edges are generally brought together with a future. There are some practitioners, however, and amongst them is M. Delpech, who consider the use of futures, even in these cases, quite unnecessary. Précis des Maladies Chir. tom. i. p. 346.

Sabre-strokes, directed obliquely downward against the face, very often produce a wound with a flap, which should be immediately laid down in its proper situation again. When the flap is large and muscular, Richter thinks it best to use a future at one or two points, as the strips of adhesive platter are apt to become displaced, especially if the patient is restless, and then the flap of skin, not being sufficiently retained, slips downwards, and the part is not healed without deformity. However, it certainly has always appeared to us that a future in this instance may be dispensed with, if care be taken to affix the effect of the adhesive platter with a comprex and bandage. First Lines of the Practice of Surgery, p. 291. edit. 3.

Sabre-wounds sometimes break and splinter the bones of the face. The fracture, however, seldom extends far, because most of these bones are soft and spongy. Notwithstanding such injury of the bones, the wound of the soft parts frequently admits of being united, if care be taken to extract all the splinters, and put the surfaces of the division of the bones as evenly together as possible. Unless the fragments are quite detached they should never be taken away, but be replaced as well as circumstances will permit. Their removal is not an easy matter, it occasions an unpleasant disfigurement, and experience proves that all divisions of the bones of the face heal with particular readinesss. (Anfgr. der Wundarzneykunft, b. ii. p. 244. edit. 3.) A very terrible fabre-wound of the face is recorded by Mr. Hennem. The weapon struck an officer nearly across the eyes, one of which it destroyed; it then divided the parts downwards and inwards to such an extent, that the pharynx could be seen. Yet the injury healed in a very favourable manner, as indeed do all wounds of the face, owing to its great vascularity. See Obs. on Military Surgery, p. 370.

In some horrid cafes, where the lower jaw is swept away by a cannon-shot, life is preferred; but, in general, the patient flinks under the accumulated tortures of his situation. “It is full, however, our duty,” as Mr. Hennem observes, “to try every expedient; and after the ragged parts and splinters of bone are removed, the vesels within reach secured, and the suppuring procexs fairly established, we may endeavour to affix nature, faithfully following any effect the may make to fill up the chasm, but without allowing ourselves to count upon a showy or complete cure.” (Op. cit. p. 373.) This gentleman saw a horrid-looking cafe, in which nearly one half of the face was carried away by a round shot at Waterloo, in a very fair progress of contraction. Larrey has likewise recorded a similar cure; and the writer of this article once witnessed in Holland a most extraordinary recovery of the same nature. It was the case of a soldier, wounded at the assault of Bergen-op-Zoom, in 1814, who was afterwards brought into one of the military hospitals of Oudenboch. All the lower jaw, and a large part of the upper, were in this instance completely torn away. There was very little hemorrhage, and no vesels required the ligation.

For some observations on wounds of the tongue, we beg to refer to the article TONGUE.

When a part of the nose is divided, but not entirely detached, it is the duty of the surgeon to replace it as expeditiously as possible. When adhesive platter does not appear to be
be capable of securing the part in its proper situation, a future may be employed. Writers usually advise keeping the nostrils perversive with soft flexible tubes, chiefly with a view of giving vent to the mucus which is secreted by the inflamed Schneiderian membrane, and which, if it could not readily escape, might prove exceedingly annoying to the patient. Putting out of the question Garengeot's extraordinary cafe, and a few others to which we have already adverted in a previous part of this article, we have many facts on record, proving not only that most incised wounds of the nose admit of union, but also that contused ones, attended with an almost complete detachment of the part, may often be united. In one instance, the cartilaginous portion of a young man's nose was nearly bit off by a horse, the separated piece only hanging by a thin portion of skin; yet after being replaced, and three stitches made, the part was united without any material deformity. Richter's Chir. Bibliothek, 6 band, feite 538, and Cooper's First Lines of Surgery, p. 282. edit. 3.

As the parotid duct passes beneath the integuments of the cheek over the masseter muscle, it is much exposed to wounds, which, if not properly treated, end in what are termed salivary fistulas. Having considered this subject in a separate article, (see Salivary Fistula,) we shall not dwell upon it at present. A late writer informs us, that in injuries of the parotid duct he has sometimes derived advantage from making the division complete by a clean incision across the duct into the mouth, and closely bringing together the edges of the wound on the outside of the cheek. The natural flow of saliva into the mouth kept the wound from healing up on the inside of the cheek. Henmon's Military Surgery, P. 374.

With respect to wounds of the external ear, experience has fully proved that they are cases which usually terminate favourably. Incised wounds and fabricuts of the ear molly heal extremely well. Ravton has recorded a case in which the ear united again, although it had been nearly separated from the head; and another instance of such success is mentioned in Cooper's Dict. of Surgery, art. Wounds. Thses and many other facts which might be quoted leave no doubt of the propriety of always making an attempt to unite parts, whenever the least connection between them remains. Surgical authors differ in their statements about the effects of the total loss of the external ear upon the power of hearing. Thus it is asserted by M. Richerand, that the external ear, which is a sort of instrument calculated for concentrating the rays of sound, may be totally cut off without deafness being the consequence. For a few days after the loss, he says, the hearing is rather hard; but the infirmity gradually diminishes, the increased sensibility of the auditory nerve compensates for the imperfection of the organic apparatus, and the acuteness of the sense is entirely restored. (Richerand, Nolographie Chirurgicale. tom. ii. p. 122. edit. 2.) However, if we are to credit the statement of other writers, the recovery is far less complete than M. Richerand represents it to be. Thus Lefchevin notices, that they who have lost the external ear, or have it naturally too flat, or ill-shaped, have the hearing less subtle. The defect can only be remedied by an artificial ear, or an ear-trumpet, which receiving a large quantity of the sonorous rays, and directing them towards the meatus auditorius, thus does the office of the external part of the ear. Prix de l'Acad. Royale de Chirurgie, tom. x. p. 120. edit. 12mo.

Wounds of the external ear, whatever may be their size and shape, do not require a different treatment from that of the generality of other wounds. The re-union of the divided part is the only indication, and it may be in most instances easily fulfilled by means of methodical dressings. Such writers as have recommended future for wounds of the ear, (says Lefchevin,) I have founded this advice upon the difficulty of applying to the part a bandage that will keep the edges of the wound exactly together. The craniun, however, affords a firm and equal surface, against which the external ear may be conveniently fixed. Certainly, it is not more easy to secure dressings on the nose than the ear; and yet cafes are recorded in which the cartilaginous part of the nose was wounded, and almost entirely separated, and the union was effected without the aid of futures. See Mem. de l. Pibrac fur l'Abus des Sutures, in Mem. de l'Acad. de Chir. tom. iii.

In wounds of the ear, then, we may conclude that futures are generally useless and unnecessary. As examples may occur, however, in which the wound may be so irregular and considerable as not to admit of being accurately united, except by this means, it should not be absolutely rejected. An enlightened surgeon will not abandon altogether any curative plans; he only points out their proper utility, and keeps them within the right limits. When flicking-plaster, simple dressings, and a bandage, that makes moderate pressure, appear insufficient for keeping the edges of a wound of the ear in due contact, the judicious practitioner will not hesitate to employ futures.

When a bandage is applied to the external ear, it should only be put on with moderate tightness, since much pressure gives considerable uneasiness, and may induce sloughing of the part. In order to prevent these disagreeable effects, M. Lefchevin advises us to fill the space behind the ear with soft wool or cotton, against which the part may be compressed without risk. Op. cit. p. 119.

In the application of futures, the ancients have cautioned us to avoid carefully the cartilage, and to few separately, one after the other, the skin of both sides of the ear. They were fearful, that pricking the cartilage would make it mortify, "ce qui elf souvenons-tois arrive," says Paré. But notwithstanding its repugnancy or authority, the moderns make no scruple about lancing cartilages. In wounds of the nose, Verduc expressly directs the skin and cartilage to be pierced at once in applying futures, and the faces of the plan is put out of all doubt by a multitude of facts. The same treatment may also be safely extended to the ear. See Lefchevin's Obf. in Op. cit., and Cooper's Dict. of Prac. Surgery, art. Ear.

Wounds of the Throat.—As Mr. John Bell has observed, there are several anatomical points which should be well remembered by the surgeon in all cases of wounds about the throat. First, it is to be recollected, that the arch of the aorta lies in the upper part of the chest in front of the trachea; and that where the carotid arteries come out of the chest to go up along the neck, they are scarcely at the sides of the trachea: they rather run before it. But, that as the arteries mount up the neck, they incline more to the side of the trachea; and that at the upper part of the neck, they are entirely behind that tube; for they incline towards the angle of the lower jaw, and having reached it, they begin there to give off their branches both to the head and neck. Hence we see the reason why a wound at the lower part of the neck is very often fatal, while a wound higher up is generally less dangerous. The suicide fondom strikes at the lower part of the neck; and it is from the accidental circumstance of his cutting very high up, near the chin, that the carotids escape.

Secondly, as the same author has explained, it should be remembered, that the carotid artery, the great jugular vein, and the par vagum, or eighth pair of nerves, lie very closely connected.
connected with each other, being all inclosed in one mass of cellular substance, which forms something like a sheath for them. Now, says Mr. John Bell, since this eighth pair is one of the greatest nerves of the viscera, and since, by experiments upon animals, we know well that a wound of it is more fatal than a wound of the brain itself, this puts an end at once to all questions about the way of managing wounds of the carotid artery, or of the great vein. No doubt these may sometimes be partially wounded and the nerve escape; but, in general, the nerve will be cut along with them; and, at all events, the fatal consequences which would arise from including this nerve in a ligature, make it absolutely necessary that whenever the carotid is tied, it be firstly separated from every other part. See John Bell's Difficulties on Wounds, p. 415. edit. 3.

That the internal jugular vein, or the carotid artery itself, may sometimes be partially injured, without a wound of the par vagum, or the patient instantly perishing, has now been fully proved. The writer of this article knew of a case, which happened in the campaign in Holland in 1814, where the internal jugular vein was ruptured by the passage of a musket ball down the neck; and yet the patient lived more than an hour after the accident, and when he died it was from suffocation, in consequence of the preflure of a large mass of extravasated blood upon the trachea. M. Larrey has related a very singular case: an officer received a gun-shot wound, which cut the external carotid at its separation from the internal, and in its passage through the parotid gland. Preflure made by an intelligent fielder at the moment, and subsequent bandages, saved the patient. (See Mémoires de Chir. Militaire.) This case is singular, because it is very uncommon for hemorrhage from so large a vessel as the external carotid to be permanently stopped by simple preflure, nor should we recommend the method to be imitated; for there is not in all surgery a better rule than that of trifling only to the ligature in every wound of a great artery. Mr. Hennem, however, informs us, that he knew of an English officer, who was also saved in India from the effects of an arrow wound in the carotid by the same means. (Obi. on Military Surgery, p. 180.) Such a mode of treatment we believe would fail a thousand times in succession; and the alleged cures would be more valuable, if it were always quite impossible to mistake hemorrhage from a branch for a bleeding from the trunk itself.

The writer of this article is acquainted with an army surgeon, in whose veracity he perfectly confides, who states, that he was once called to a soldier who had wounded the trunk of the carotid with a bayonet. The vessel was instantly taken up, and the man's life saved. In a modern publication may also be found another example, in which the carotid burst, and was taken up on the spot by Mr. Fleming, a naval surgeon. See Medico-Chir. Journal, vol. iii. p. 2.

Without positively maintaining, as Mr. J. Bell does, that it is impossible to cut through the trachea so as to open the oesophagus, without wounding the carotid artery, the jugular vein, and the eighth pair of nerves, we join him in believing that such an accident must be exceedingly rare. How then are we to explain the many alleged cures which are said to have been effected, notwithstanding the windpipe and oesophagus are slit to have been both cut through? We are to account for these extraordinary narratives in the manner so well pointed out by Mr. John Bell. "The fact is (says he), that neither the oesophagus nor the trachea is touched in the least degree, but the wound is much above them; for a suicide always strikes immediately under the chin. This wound, as far as I have observed, commonly falls in the line which divides the neck from the chin; that is, the place where the os hyoides lies, and he commonly cuts the os hyoides away from its connection with the thyroid cartilage, or pomum Adam. In that case, the thyroid cartilage, forming the uppermost part of the larynx, is not touched; the rima glottidis lies below the wound quite safe. The wound indeed separates the epiglottis from the glottis; but it leaves the glottis and the larynx quite safe. It only separates the larynx from the root of the tongue; it is properly a wound in the root of the tongue; it is rather a wound of the mouth than of the throat; and when the food comes out, along with spittle and froth, it is by rolling over the root of the tongue." On Wounds, p. 417.

That, however, the trachea and oesophagus may be both cut in a few cases, without immediate death from hemorrhage, we decidedly believe, because there are too many facts on record to admit of any doubt on the subject. See Default's Journal and Saviard, obf. 58. Hemen's Military Surgery, p. 386.

In these high wounds of the throat, it is the thyroidea, which is most frequently cut. This vessel, after quitting the external carotid at the angle of the jaw, paffes along the side of the upper part of the trachea, inclining forward towards the thyroid gland in its descent, and being therefore much exposed to the edge of the razor. The bleeding from this artery is profuse, and if not speedily stopped is as fatal as hemorrhage from the carotid itself. In some of these cases, the bleeding also proceeds from branches of the lingual artery.

Wounds of the carotid artery, or jugular vein, commonly prove immediately fatal from loss of blood, before any assistance can be obtained. If a surgeon, however, were to arrive in time to render aid, it would be his duty immediately to apply a ligature both below and above the wound of the vessel. This is the only plan which affords any chance of saving the patient's life, and, as we have already noticed, it has actually been done with success in a few uncommon instances, in which the surgeon was not too late. In passing the ligatures beneath either of those vessels great caution is requisite; for the eighth pair of nerves lies close to it, included in the same sheath of cellular substance, and the inclusion of so important a nerve in the ligature would have fatal consequences. Its situation on the outside of the artery, between it and the jugular vein, should therefore be always carefully remembered. According to Richter, the internal jugular vein has actually been tied with success. Small wounds of the same vessel, if we are to credit the accounts of this author, may sometimes be healed by means of a graduated compres, which must be retained on the part with a bandage, or, if that prove irksome, with the finger. One thing, however, is essential; namely, the preflure must on no account be remitted, until the wound in the vessel is closed. Richter's Anfangsri. der Wundartz. b. iv. p. 173, and Cooper's First Lines of Surgery, p. 386. edit. 3.

M. Pellécan once saw a wound of the throat, which proved fatal in consequence of hemorrhage from the external jugular veins; and the same eminent surgeon met with another curious instance, in which a boy, who was convalescent after a cut of his throat, suddenly fell down in a state of suffocation and died: on examining the parts after death, it was discovered, that the left side of the epiglottis had been detached from the glottis and root of the tongue, and that in this bose unconnected state it had fallen upon the rima glottidis, and clofed it to completely as to cause instantaneous suffocation. See Leveillée's Nouvelle Doctrine Chir. tom. i. p. 342, 343.
WOUNDS.

Wounds of the trachea are either simple or complicated. In both descriptions of cures, the usual symptoms are, an emittance of air between the lips of the wound, loss of the voice, and sometimes emphysema. Such injuries of the windpipe as are not complicated either with hemorrhage, emphysema, or loss of substance, may for the most part be easily cured by means analogous to those which are employed for the cure of wounds in general. The re-union is more easily accomplished, when the trachea is divided longitudinally, than when it is cut transversely. If the wound be of a certain size, and attended with hemorrhage, the first indication is to tie the bleeding vessels, and, in particular, to obviate the inconvenience and danger which would result from the insufflation of the effused blood into the windpipe; an occurrence which has sometimes proved fatal. (Wilmer's Cales and Remarks in Surgery, p. 92.)

In order to prevent such an unfavourable event, some surgical writers recommend the external wound not to be closed while any oozing of blood continues, so that this fluid may readily find an external outlet, instead of falling into the trachea. (Laffin, Pathologie Chir. tom. ii. p. 291.) To us it appears, that the best mode of preventing the occurrence is to bring the edges of the wound of the trachea into contact by a suitable position of the patient's head, and, if requisite, even by a future.

The greater sensibility of the larynx, its complicated structure, and the number and size of its blood-vessels, *suctis paribus*, render wounds of it much more dangerous than those of the trachea. In the first volume of the Mémoires de l'Acad. de Chirurgie in 140, many cases may be consult which furnishes proofs of this observation. In general, however, wounds of the thyroid cartilage heal very favourably, when not accompanied with injury of other important parts.

Transverse wounds, dividing only the anterior half of the upper part of the trachea, usually have a favourable termination, and when the cases are of this description, the carotids and jugular veins for the most part escape injury. Gun-shot wounds of the trachea are more dangerous, but experience proves that they also frequently end well.

The greater number of transverse wounds of the trachea, which have not divided this tube completely through, readily admit of cure by the strict observance of a proper position. When the patient's chin is brought downward and forward towards the sternum, and the head is maintained in this position with pillows, the edges of the wound in the trachea become spontaneously approximated to each other, and in time will grow together.

The manner in which the employment of futures aggravates the cough, and inflames the wound, often necessitates the surgeon to withdraw them when they have been applied. It may also be truly asserted, that besides the irritation which they create in the trachea as extraneous substances, they are (to say the best of them) very unnecessary. Nothing has a greater tendency to impede the union of a wound of the trachea than the disturbance of a frequent convulsive cough; and the irritation of futures always increases this hurtful symptom in a much greater degree than they can do good by maintaining the edges of the wound in contact. In fact, unless the greater portion of the diameter of the trachea be divided, there never can be such a space between the edges of the wound, that they cannot be brought together with the assistance of a judicious posture of the head.

When the patient is much afflicted with incoherent coughing, and the inflamed state of the wounded parts appears to operate as the cause of this disagreeable symptom, relief is to be obtained from bleeding, and the exhibition of soothing and aperient medicines. In cases in which no particular local irritation can be suspected of giving rise to the cough, the surgeon may prescribe the almond emulsion, *fpermaceti* mixture, and opium, which will frequently be found remedies of the most decided efficacy.

In order to prevent the entrance of the discharge and blood into the trachea in particular instances, the plan has been tried of making the patient lie on his side, with his face turned downwards. (See Méth. de l'Acad. de Chir. tom. i. p. 581.) But, although the case here referred to ended well, we believe, as already explained, that nothing prevents the entrance of blood or matter into the trachea so effectually as keeping the edges of the wound of this tube accurately in contact, which is to be principally effected by bringing the chin down towards the breast. This is an object which is far more difficult of accomplishment, where the patient lies on his side, than when he remains, as is most usual, upon his back.

When a wound has detached the upper portion of the trachea from the lower one, and it is not immediately fatal from the injury of other important parts, the bleeding vessels are first to be tied, and the two ends of the trachea are then to be brought into contact. In this sort of case, we believe that the employment of a future is warrantable, on account of the immense separation of the divided parts, and the inefficacy of position alone to prevent it. But, even in such a case, a few stitches will be quite enough when the chin is properly approximated to the sternum, and the needle should never be introduced through the membranous lining of the windpipe, as it is very sensible, and much disposed to inflammation.

The hoarfeness and weaknefe of the voice, sometimes remaining after the wound is healed, often gradually disappear.

Many surgical writers recommend the patient to refrain from making forcible expositions, and from drawing the head suddenly backwards, for a certain time after the wound is healed. By such caufes, it is affered, the recent coalescence of the wound may be easily destroyed.

Wounds made with bullets, which strike the side of the neck and lacerate the trachea, have frequently been ob¬served to terminate well. (Mém. de l'Acad. de Chir. tom. iii. p. 151, &c. edit. 12mo.) Ravon mentions several in¬stances, which not only got well, but were also followed by a recovery of the voice.

Sutures are not applicable to these cases. A strict adoption of the position recommended above, and the application of an emollient poultice contained in a fine linen bag, are the chief local chirurgical measures. The use of leeches, venefication, saline medicines, and antiphlogistic remedies of every description, will also be generally proper. (See First Lines of Surgery, p. 387, edit. 3.) Opium is like¬wise not to be forgotten as an extremely useful medicine in cases of wounds about the throat: it not only appeases the cough with which such injuries are often accompanied, but tends to quiet the great mental and nervous anxiety which in examples of attempted suicide existed previous to the in¬flammation of the wound, and generally continues for some time afterwards in a very aggravated degree. Indeed, many of the unhappy persons who attempt to destroy themselves by cutting their throats, flill retain for a good while after the failure of the first attempt, a determination to take another opportunity of accomplishing their fatal purpose; hence such patients cannot be too closely watched, and nothing like a razor or a knife should ever be put within their reach. The necessity of a constant vigilant attendant is also...
WOUNDS.

...necessary, in order to hinder the dressings from being pulled off, and the wound torn open again, by the reflexes movements or actual violence of the patient.

In cases in which the whole diameter of the trachea is cut through, the French surgeons have proposed the introduction of a flexible catheter from one of the nostrils into the larynx and trachea, in order to insure a passage for respiration, which, they say, without this means is liable to be completely intercepted when the outer wound is closed, in consequence of the two portions of the windpipe being drawn away from each other and not corresponding. (Richerand, Nofogr. Chr. t. iv. p. 175. edit. 4.) This, however, would not be the practice to which we should give a preference; first, because the introduction of a flexible catheter is a thing which cannot always be accomplished with facility; secondly, because its use in this way is constantly productive of considerable irritation; and, thirdly, because we deem the employment of a future the best means of hindering one part of the trachea from becoming separated far from the other, and thus of insuring a passage for respiration.

With respect, however, to the introduction of a flexible catheter from one of the nostrils into the æsophagus, for the purpose of giving food and medicines to the patient, without any motion or disturbance of the wounded parts, we consider the method entitled to the highest praise in all cases of serious wounds, either of the larynx, the trachea, or the æsophagus. When a person swallows, the muscles concerned in the elevation and depression of the larynx act in a sudden convulsive kind of manner, and cause a most injurious disturbance of the wound. But when nourishment and medicines are injected into the stomach through a flexible tube, introduced from one of the nostrils down the æsophagus, this hurtful action of the muscles is entirely prevented; for the instrument may be kept there without any annoyance or irritation, and the requisite quantity of aliment, and whatever internal remedies may be indicated, can be given with the utmost convenience. We consider this use of flexible catheters as constituting a very material improvement in the treatment of severe wounds of the throat.

The military surgeon, in particular, should never be without these instruments; and whoever has read the relations of M. Leroy, in his Mémoires de Chirurgie Militaire, will see, that sometimes in bad wounds of the throat, the patient's chance of recovery depends almost entirely upon the aid to be derived from the skillful employment of an elastic gum tube.

Wounds of the æsophagus may either amount to a total or partial division of that tube; they may be either with or without a total division of the trachea; and with or without injury of other important parts in the vicinity. Hence such wounds are sometimes absolutely fatal; and, in general, when they admit of cure, nature has a greater share than art in bringing it about. Some benefit, however, is to be derived from good surgery, and infinite harm may result from bad.

A total division of the æsophagus must prove immediately fatal. The inevitable simultaneous injury of other important parts would render such a case at once mortal. The celebrated Prussian surgeon, Schmucker, has treated small wounds of the pharynx and upper part of the æsophagus with success. Wounds dividing half or even two-thirds of the tube are also flayed to have been cured. (Mém. de l'Acad. de Chir. tom. iii. p. 131. edit. 12mo.)

The possibility or impossibility of a cure must obviously depend upon what other parts of consequence are injured.

Incised wounds, which divide the front of the æsophagus, must derive additional danger from the simultaneous division of the whole circle of the trachea; and, indeed, so much would the internal jugular vein, par vagum, and carotid artery, be exposed to the edge of the knife in a cut of this kind, that it is difficult to conceive how they can ever escape. Mr. John Bell, as we have seen, believed that they never could; and were it not for the many examples published, some of them by such a man as Defaint, and for an instance which was lately in St. Bartholomew's hospital, we should have joined Mr. J. Bell in thinking, that all reports of this kind were mistakes, arising from the wound extending through the root of the tongue into the mouth, and not actually injuries of the æsophagus itself.

A punctured wound, penetrating the side of the æsophagus, may not be complicated with injury of the trachea, and therefore may not be attended with so much peril as an incision. But although flabs injuring the æsophagus are not regularly and certainly mortal, they are always to be regarded as dangerous cases.

Should the case be one of those fortunate incised wounds which leave the great vessels uncut, though the injury of the æsophagus be complicated with a complete division of the trachea, the surgeon can lessen the space between the edges of the wound in the æsophagus by bringing the divided portions of the trachea together. This effect must result from the manner in which the posterior part of the windpipe is connected with the æsophagus. But for this purpose, a future is only to be used in such a state of the wounded trachea as amounts to a total division of the tube; for in all other cases, a proper position of the head, and the use of adhesive plaster to the external wound, should be the means with which the surgeon ought to be content, with a view of bringing the margins of the wound of the trachea near to each other.

In cases of wounds of the æsophagus, it was recommended, as long since as the time of Ravanot, to inject nourishment and medicines into the stomach, through a smooth tube of a suitable size, introduced down the pharynx. In one case of paralysis of the æsophagus, which occurred in this country, a small fresh catgut was passed down this canal, by means of a whale-bone pro- bang, in order that medicines and food might be injected into the trachea. (Hunter, in Trans. for the Improvement of Med. and Chirurgical Knowledge.) The many cases, however, in which Defaint advantageously employed an elastic gum catheter for the same objects had a principal influence in establishing the practice. The instrument was introduced through one of the nostrils, and was often left in the æsophagus for several days together. (See Œuvres Chir. de Defaint par Bichat, tom. ii.) The introduction of elastic gum catheters down the pharynx and æsophagus is not only highly necessary in examples of paralysis, and wounds of those passages, but it is an exceedingly useful practice in wounds of the trachea, where the convulsive action of the muscles in deglutition would otherwise create a very hurtful disturbance of the injured parts. (First Lines of Surgery, p. 38, 39. edit. 3.) The practice is also sometimes absolutely necessary in many complicated wounds about the face, such as those produced by the discharge of a pistol into the mouth, and attended with extensive laceration of the tongue, cheeks, and face, and a comminuted fracture of the lower and upper jaw-bones. We believe, indeed, that in all fractures of the lower jaw, the introduction of a flexible catheter from one of the nostrils into the æsophagus is an extremely judicious measure, because the action of deglutition has a greater effect in displacing the broken bone and disturbing the process of union than any other circumstance.

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Gun-
WOUNDS.

Gun-shot wounds of the neck sometimes occasion an immediate loss of the use of the arm on the affected side; a circumstance which may in general be accounted for by the injury of some of the cervical nerves, in their deficient to and from the axillary plexus. See Hennem's Military Surgery, p. 378, and Thomon's Report of Observations made in the Military Hospitals in Belgium, p. 75, 76.

Wounds of the Thorax, or Chest.—Of some of these injuries penetrate the cavity of the thorax; others are more superficial, only affecting the skin and muscles, and not extending through the pleura costalis. When the latter cases are produced by sharp-cutting instruments, and the only indication is to accomplish an union of the divided parts, as happens in incised wounds of the skin, latissimus dorsi, pectoralis major, &c. such injuries are not materially different from any simple wounds of other parts of the body, and require a similar mode of treatment.

But where much violence has been applied to the paites of the chest, and the concussion has operated so forcibly as to affect the heart, lungs, and other important organs, the wound, although Simple in appearance and not penetrating the chest, may nevertheless be followed by alarming symptoms, either at first or consecutively; such as inflammation of the lungs, spitting of blood, and difficulty of breathing, as is frequently observed in contused and gun-shot wounds of the paities of the chest. A violent blow on the dorsal verterbrae is also said to have given rise to a dilatation of the heart, and an aneurism of the aorta. Laffus, Pathologie Chir. tom. ii. p. 305.

Thus professor Thomon, in his account of the wounded whom he observed after the battle of Waterloo, remarks, "We saw far mire thanes in one n which a ball, in palling across a portion of the paities of the thorax, without penetrating that cavity, had excited an alarming and dangerous degree of inflammation of the pleura. In one of these, the ball had taken an oblique direction along the lower part of one of the sides of the chest. In another it had struck against a strong leathern belt that was suspended over the right shouder, made a deep indention in this belt without penetrating it, and produced a severely contused wound at the inner extremities of the frith and second ribs of the right side. This patient suffered much from inflammation. The injured portions of the ribs had exfoliated and come out, and the motion of the lungs in inspiration and expiration was perceptible from the sinking and rising of that part of the paities which had been deprived of its bony support. In another remarkable case, the ball entered above the middle of the clavicle, and passed out at a point direcly behind. Neither at the frith, nor at the time we saw this case, was there any reason to believe that the ball had wounded the pleura. Inflammation, however, of this membrane came on, which terminated in suppuration. The operation for empyema was performed, and about four pints of pus evacuated." Reports of Obf. in the Military Hospitals in Belgium, p. 82.

In wounds of the chest, it is often difficult to pronounce with certainty whether they penetrate into the face of the pleura; but all doubts with regard to this point are removed the moment we observe air coming out of the wound upon coughing. That the lungs have been wounded may be inferred with nearly equal correctness in every case, in which a person spits blood immediately or soon after receiving a wound of the chest.

It rarely happens that a wound penetrates the cavity of the thorax without producing more or less injury of the lungs, and the danger of the latter accident is in proportion to its depth, its situation, and the fize of the weapon with which it was inflicted. A wound of the lungs with a small sword seldom gives rise to much effusion of blood in the chest, unless some of the large vessels of those organs happen to be hurt. Putting this circumstance out of present consideration, the usual symptoms which the patient suffers are, a spitting of blood, cough, and difficulty of breathing, succeeded by a good deal of symptomatic fever.

"To discover whether the wound has injured the lungs or not, (says a late writer,) is a point which has given to the older surgeons great room for employment of their ingenuity in devising possible cafes, and has occasioned so small a rate of time and wax-tapers in ascertaining the exit of air through the paffage. A practifical surgeon will require but little investigation; bloody expectoration immediately on receiving the wound, and the terrible symptoms of dyspnoea, fene of irritufcre and suffocation, infupportable anxiety and faintness which succeed, soon enough discover the fact; and if by good fortune no intimation is given in this way, happy is the surgeon, and thirce fortunate the patient."

"The immediate danger in wounds of the lungs is either from debility from hemorrhage, or suffocation from the blood flowing into the air-cells and cavity of the thorax. The effusion of air forming emphysema is also a troublesome, but (as Mr. Hennem believes), taking it abstractedly, is not a dangerous symptom of those injuries; neither (says he) is it by any means so frequent as has been supposed. The symptoms that I have now enumerated, whether single or in combination, may be deemed the primary effects of wounds of the thorax. Violent inflammatory adfections of the lungs and the membranes ever subjefct to relapse; long and tedious suppurations and exfoliations of the bones are the secondary, and though not so rapidly fatal are often as certainly so as the others. Diseafes which, although we cannot strictly call them pulmonary consumption, agree with it in many points, particularly in cough, emaciation, debility, and hectic, are often the consequences." Obf. on Military Surgery, p. 395.

When the weapon is broad, and it has entered the subsidence of the lung, the hemorrhage is considerable; blood is immediately extravafated in the cavity of the thorax, and also flows out of the external wound; the patient has a violent paroxysm of coughing, in which some of the blood is ejected from the mouth; the air comes out of the chest with a hissing noise; and if the outer wound be not parallel to that of the lungs, empyema takes place. As we have already stated, the danger of such an injury depends upon the depth of the wound, and the size of the vessels which are opened. Some patients recover, while others die instantaneously, or in a very short space of time.

As an interesting author remarks, it is a thing really wonderful, "that the thorax, containing the heart, lungs, and great vessels, should be so often wounded with so little danger. Many no doubt die, but numbers escape; for a wound of the subsidence of the lungs is far from being mortal. The blood may suffocate the patient; the fever and pain may waffe him; he may die of the inflammation, or of the oppression of the lungs; or there may be time for a large suppuration, or a lingering hectic to cut him off; but if, his wound be only in the edges of the lungs, he is in some degree safe. He is only in danger when the thick subsidence of the lungs is perforated, and falls into absces, or when the root of the lungs is wounded; for there the large vessels of the lungs being opened, the great effusion of blood, like that from a wound of the heart itself, must kill, even by the quantity of blood lost to the general sytem. But besides, this blood, being thrown into the trachea,
WOUNDS.

trachea, deluges the lungs; the patient spits up a frothy blood; blood, instead of air, occupies the bronchi; so that he struggles for breath but a few moments, and then expires.” John Bell’s Discourse on the Nature and Cure of Wounds, p. 257, edit. 3.

We shall next consider the treatment of penetrating wounds of the chest. In these cases, the patient may die instantaneously of internal hemorrhage and suffocation; or he may be cut off by the effects of inflammation within the cavity of the thorax. If (says Mr. John Bell) the patient be pitting blood and breathing high, but not much oppressed, or his oppression increasing very slowly, there are hopes that he may be favored. If there be no great vessel wounded in the lungs so as to suffocate him at once, it is probable that the smaller vessels which are opened by the wound will gradually cease to bleed; and after four or five days of alarming cough, with bloody expectoration, that symptom will cease; and in order that he may the sooner be relieved from his danger, he must be bled very freely. Let it be the intention to reduce him very low by quick bleedings; and let these bleedings (says Mr. John Bell) have the effect of continued internal hemorrhage, without the dangers of it. Let them depree him to the fame low condition to which the inward bleeding would most likely have brought him; and the systen being emptied in this direction, there will be less danger of immediate suffocation in the lungs, and but little fear of the succeeding inflammation rising too high. It is only by these repeated bleedings that the patient can be saved: the vascular system must be kept low in action, and so drained as to prevent the lungs from being oppressed with blood.

One thing (continues the same author) is very clear, that if the surgeon bleed only when the cough and bleeding from the lungs return, he never can do wrong. The patient, lying struggling before him, is to lose a given quantity of blood; if it be allowed to flow out into the lungs he may be suffocated; if it be drawn from the arm, this suffocation is prevented. If he be kept low enough by bleeding, there will be no blood to spare for this extravasation into the lungs, &c. (Op. cit. p. 259, 260.) We repeat, in all cases of penetrating wounds of the chest, and especially in injuries of the lungs, the free use of the lancet is the only thing which can be depended upon in the early part of the treatment. By it, internal hemorrhage is restrained; and by it, the dangers of the subacute inflammation of the thoracic viscera are to be averted. The records of surgery furnish abundant proof of the necessity of such practice, and the extent to which the bleeding must be carried is sometimes surprising. Thus, in a case in which a mullet-ball had entered the left shoulder, passed through the lungs, and come out below the left nipple, a profuse hemorrhage of arterial blood took place from the mouth, and threatened immediate suffocation. This hemorrhage was checked by repeated bleedings, which were referred to on every fresh attack of the hemorrhage, and pushed till relief was obtained. Leccehs were applied to the sde in great numbers, and the antiphlogistic plan of treatment was strictly pursued. Two hundred and fifty ounces of blood were in this case drawn off by the lancet in eighteen days. (See Thomson’s Reports of Obs. made in the Military Hospitals in Belgium, p. 86.) In every instance of a penetrating wound of the chest, and more particularly when the lungs are injured, the first bleeding should be copious. As Mr. Hennen recommends, from thirty to forty ounces of blood should be taken from the arm by a large orifice. If the patient should faint, we ought not to administer cordials to him, but allow him to revive gradually. We should avail ourselves of this opportunity of extracting without pain all foreign bodies within reach, whether cloth, ball, iron, wood, splinters of bone, &c. Should there be reason to think that such extraneous substances are lodged, and that by enlargement of the orifice of the wound they might be extracted, the practice ought to be immediately adopted.

The next object is to dress the wound itself. “If it is a gun-shot (says Mr. Hennen), a light mild dressing will be sufficient; but if incised, the lips of it should be closed at once, and this treatment will be found to afford the most certain preventive to emphysema (see EMPYEMA), future hemorrhage, and collections of matter. (See EMPYEMA.) I scarcely recollect an instance where it was necessary to remove the adhesive strips, or (where it was a gun-shot) the usual dressings. We now lay the man down, and let him remain as quiet as possible, and in as cool and airy a spot of the barn, church, or hospital, as we can find. He will often require no farther aid; but if the case is very severe, he will probably lie for some hours in a state of comparative ease, till the vessels again pour forth their contents, and induce fresh spitting of bloody froth, and a repetition of all the symptoms of approaching suffocation. The lancet must again be had recourse to; and if by this management, repeated as often as circumstances demand, the patient survives the first twelve hours, hopes may begin to be entertained of his recovering from the immediate effects of hemorrhage. In the after-treatment of a wound of the nature here described, we shall be considerably assisted by the aid of medicine; but until the danger of immediate death from hemorrhage is over, we must not think of employing any thing except depletion by the lancet: it, and it only, can save the life of the wounded man.” Hennen’s Obs. on Military Surgery, p. 398.

When the paroxysms of pain, the sense of suffocation, and return of hemorrhage, says Mr. Hennen, have become more moderate, and recur at longer intervals, we may have recourse to means of less immediate influence, and spare the lancet. In this view, the most powerful medicine that we can administer is the different preparations of digitalis, in such form as may best agree with the patient; and if the pain and efforts to cough are severe and irascible, we must have recourse to the aid of opiates. To this course of medicine should be added a rigour of diet, amounting to the total prohibition of every thing solid, and admitting of fluids only of the mildest nature and least irritating quality; and even those in small quantities, and duly acidulated. Should we be fortunate enough to preserve our patient during the first six or seven days, a relaxation in this rigour may be cautiously admitted; but a departure from the general plan, or an omission of bleeding on the rising of the symptoms, can only tend to accelerate the event that our efforts are designed to counteract. Mild saline purges, and an emollient enema, should be occasionally administered if required, and the patient kept in a state of the utmost quiet and seclusion from all external impressions, and in a cool atmosphere. (Op. cit. p. 400.) The plan of exciting a counter-irritation on the surface of the chest, by means of blisters, should also never be omitted, when much cough and pain in the breast continue after bleeding has been fully practised. In some examples, the inflammation occasioned by penetrating wounds of the chest terminates in suppuration within the lungs, or the case of the pleura. The symptoms, however, which indicate such an occurrence, and the mode of treatment, are so amply explained in another part of this work (see EMPYEMA), that we shall not enter into the subject again.

There is one circumstance which sometimes deceives the surgeon,
WOUNDS.

surgeon, and leads him to suppose that the case is a penetrating wound of the thorax when it is not so. We allude to the occasional examples in which a musket-ball pierces the skin and muscles on the outside of the chest, runs round the ribs, and makes its exit nearly opposite the point of entrance. Here the absence of bloody expectoration and other symptoms of injured lungs, together with the direction of the commencement of the track of the ball, will sometimes convey useful information to the discerning practitioner.

There is also another source of deception as to the actual penetration of balls into the cavities of the body; this is when they strike against a handkerchief, linen, cloth, &c. and are drawn out of the wound unperceived in a fold or pouch of those materials. M. Larrey, Mr. Hennen, &c. have published examples of the occurrence.

Wounds of the chest are sometimes complicated with the lodgment of extraneous substances in that cavity, and this sometimes without occasioning fatal consequences, either immediately or subsequently. Thus Mr. Hennen informs us, that in examining the bodies of soldiers who have died from those injuries, he has frequently found pieces of wadding, of clothes, epiploic of bone, and balls, and, in one case, some charpie used as a dressing, either loose in various parts of the lungs, or lying in fact, formed by a deposition of coagulating lymph. In some more fortunate patients who recovered, such matters were discharges or extracted from the wounds; and in certain other lucky examples they were ejected by the convulsive efforts to cough, which their irritation had excited. (Obf. on Military Surgery, p. 390.) The same author relates the following interesting case, to prove that a much larger mass than a bullet may pass even through the lungs, without doing away all chance of recovery.

A soldier of the guards was wounded through the thorax at Waterloo, between the third and fourth ribs of the right side. On his arrival at Bruffelz, he was placed in an hospital and dressed. Nothing remarkable occurred for the first five days; and the only singularity in the appearance of the wound was its large size, capable of admitting three fingers conically placed. Blood and air were freely discharged from it. On turning the man to examine him, and renew the dressings, a tumour was discovered on the scapula, from which was extracted his breast-plate, about two-thirds of which were rolled up by the force of the blow into a figure somewhat resembling a candle-extinguisher, with the musket-bullet contained within it. The other third was broken off; but it had also passed through the wound, and was extracted. The man survived the injury three weeks, and afforded great hopes of his perfect recovery; but in a gust of passion, he one night tore the dressings off his wound, and was found dead the next morning. The body was not examined. Op. cit. p. 392.

Balls have been found in the fibulatio of the lungs twenty years after their entrance, the patient being all that time in perfect health, without any symptom characterizing the peculiar situation of such foreign bodies. There are also on record instances in which a ball has rolled about in the cavity of the thorax on every motion of the body. (See Baron Percy’s Manuel du Chirurgien d’Armée, p. 25; Magatus’s Bibliotheca Chirurgica; and Hennen’s Military Surgery.) In general, however, balls lodged in the thorax become as it were encysted and fixed by the deposition of coagulable lymph around them, and the formation of a sort of case.

Several authors have noticed, that when a penetrating wound of the chest is of a certain size, a portion of the lungs sometimes forms a protrusion between the ribs. In the majority of such cases, there can be no doubt of the propriety of immediately reducing this sort of hernia, and keeping it so replaced by means of a suitable apparatus. We learn, however, from the observations which have been collected on this subject, that the protruded part of the lung has sometimes been tied, or cut away, without any ill consequences. Fabricius Hildanus records the case of a man who was wounded with a sword between the fifth and sixth ribs, near the sternum, and in whom a piece of lung protruded. On examination it presented a livid appearance, and the discoloured part was therefore cut away with a heated knife. The rei was reduced, after separating the two ribs, from each other, as far as possible, by a wooden wedge. Notwithstanding this extraordinary method of treatment, the patient soon recovered, and lived without experiencing any oppression in respiration. See Centur. 2. Obf. 32. p. 108.

The livid appearance of the lung, as M. Laffus observes, arises from its exposure to the air, and the manner in which it is intertangled between the two ribs. It affords no proof either that the protruded part is gangrenous, or that it ought to be cut away. (Pathol. Chir. tom. ii. p. 359.) A writer (fays he) who is very little known, and whose case we shall relate, confes his havingmitaken this livid discolouration for a sign of mortification. A man received a stab between the third and fourth ribs, on the right side of the chest, and by the way in which the sword had been withdrawn, the wound was rendered very large. A portion of the lungs protruded, swelled considerably, and remained in this state three or four days without any attempt being made to reduce it. The part then became shrunken and quite dry, when the whole of what was external to the ribs was cut off. On dipping the piece of lung in water, however, it immediately resumed its natural colour, which, no doubt, it would also have done had it been reduced instead of being amputated. The patient nevertheless got quite well, and suffered afterwards no difficulty, notwithstanding the hard laborious life which he was obliged to lead. Obf. Medicinales et Chirurgicales par Loyfeau. p. 25.

A similar mistake was made on a patient who had received a wound which penetrated the anterior and inferior part of the chest. A small bit of the lungs protruded, which was supposed to be a piece of omentum, and was immediately included in a ligature. Ruytsch being consulted, perceived the mistake, and he recommended dressing the wound, and leaving things as they were, until the tied portion of lung had become detached. No bad symptoms followed, and the patient perfectly recovered. (Obf. Anat. Chir. obf. 53.) We met with a protrusion of a long piece of the lungs in a soldier, who had been wounded with a lance at the battle of Waterloo. The part was at first four inches in length, and shaped like a tongue. As it was considerably contused and torn, we doubted the prudence of returning it in that state into the chest. We thought, therefore, of cutting it off, but fearful that it might bleed freely, we first made a small incision into it, in order to ascertain the fact; and as a good deal of blood began to flow from this little incision, we first tied the protruded part close to the ribs, and then removed all that was exterior to the ligature. The patient was so well on the day of the operation, and also the next morning, that he would not remain in bed; but we were informed that he did not ultimately recover.

A wound of one of the intercostal arteries immediately produces a degree of hemorrhage, which is manifest externally, and often considerable. The blood flows out of the wound, and also into the cavity of the chest. It issues per
WOUNDS.

As to the syptoms of an extravasation of blood in the thorax, and from the effect which even the discharge of such blood may have in renewing the hemorrhage, and making room for another effusion, in cases where the injured vessels are large. The blood, however, must be discharged when the symptoms of suffocation are urgent, and evidently owing to the preface of the extravasation on the organs of respiration. The practice of making an opening will always be unsuccessul, when the wound of the lungs, besides being deep enough to give rise to an extravasation, is also complicated with emphysema of the organs, and the effusion of a considerable quantity of blood into their cellular and parenchymatous texture. In short, in a wound of this serious description, it does not constantly happen, that the only curative indication is to discharge the extravasated blood. The degree of danger depends upon the nature of the wound of the lungs, which is inviolable, and of which it is sometimes difficult to form a correct judgment. Frequently an extravasation of blood in the pericardium, without injury of the heart, but a caufe which is always fatal, has been mistaken for an extravasation in the cavity of the left pleura. Sometimes, also, we may be deceived, and believe in the existence of an extravasation, while the symptoms of suffocation under which the patient labours may be owing to the sub stance of the lungs being changed as it were into a solid mafs, by the effusion of blood and coagulating lymph in their texture, and the consequent compression of the air-cells.

Although it must be acknowledged, that the diagnosis of an extravasation of blood in the cheff is not free from difficulties, the following are usually regarded as the symptoms which characterize the case, either in the primary or secondary form. In the first place it is obvious, that there must generally be a wound of the lungs, which is indicated by the issue of frothy blood from the wound, by the passage of air through the wound into and out of the cheff, and by the patient spitting blood, or coughing it up in large quantities. If, however, the blood come from the intercostal artery, no blood will be coughed up. At the moment of receiving the wound, the patient falls into a state of syncope, and though the bleeding may not be very considerable, he is affected with cold sweats, and his pulse is feeble and small. In the course of a few days, notwithstanding a low diet, repeated bleedings, and perfect quietude, respiration becomes short, difficult, and laborious, and inspiration is observed to be performed more easily than expiration. The patient usually lies upon the side in which the extravasation is; and this side seems rather larger and broader at its lower part than the opposite side, on which the patient cannot lie without an aggravation of all his sufferings. When he tries to sit up in bed, he cannot remain in this position, unless he bends his body very much forwards, in order to facilitate respiration. Above the xiphoide cartilage and the lateral parts of the cheff, he feels a weight, attended with a frequent cough, and a sensation of suffocation. According to Valentine, in large emphysemos, or violet-coloured spot, makes its appearance in some individuals in a later stage of the case about the angles of the fable ribs; but this symptom is far from being constant, and it did not occur in an instance of extravasation of blood in the thorax recorded by Dr. Thomfon. (Reports of Observations made in the Military Hospitals in Belgium, p. 85.) In general, blood escapes from the wound, unless the opening be very small, or situated in the upper part of the cheff. Lastly, it is remarked, that the symptoms of suffocation proceeding from inflammation of the lungs subside, or are evidently killed by venesection, which is not the caufe when they depend upon an extravasation.
WOUNDS.

If it be true that some patients have had their breathing very little oppressed, notwithstanding an extravasation of blood in one of the cavities of the pleura, and that others have been able to live with equal safety either on the found or diseased side (see Thomson’s Report, p. 87.), which is not common, we must conclude from these unusual cases, that we ought not to form our opinion from any one symptom in particular, but from the assemblage of a great many.


On the subject of extravasations of blood in the thorax, the following are the sentiments of a distinguished writer: “Whatever may be the cause of this inward bleeding, the surgeon should attend to the following directions. He should first put his finger into the wound; perhaps it may discover the canful, or may evacuate the blood. If the blood do not follow the finger, then some tube must be introduced, and the tube for a ample operation need not be a nice one. If he cannot get the tube into the thorax, and the breathing continue oppressed, he must enlarge the wound, and enlarge it freely. To be afraid of exposing the lungs to air when they are already torn with a bullet and loaded with blood is childish and welfe’s theory, very unlike the proper management of such wounds. If the wound in the thorax be not too high above the third or fourth rib, and if no posture of the patient, however willing or able to turn himself, will bring the blood easily in that way, or if the wound be contused, oblique, and difficult to dilate, an operation must be performed, which, as it is commonly practiced for pus in the breast, is called the operation of Emphysema (see this word); that is, a very fine incision must be made in the line betwixt two of the ribs; then the pleura must be punctured with a lancet, and a tube introduced. Or, in plain language, whenever it is found that the natural wound will not empty the thorax, a new wound should be made in what is called the chosen point, or the point of election, i.e. low, betwixt the seventh and eighth ribs, that there may be an easy flow. But whenever the wound is about the middle of the thorax, it should rather be dilated, which both changes the nature of the wound and gets out the blood. When this blood proceeds from a wound of the intercostal artery, such free incisions are the more necessary; they allow us to see the artery, to feel the jet of its warm blood by putting in the finger, and this allows us to press it with a compress, or tie it with the needle and thread.” (See John Bell’s Discourses on Wounds, p. 263, 264. edit. 3.)

However, notwithstanding this author, and a few other surgeons thus talk of taking up the intercostal artery, we much doubt the possibility of the thing, nor do we know of any well-authenticated case on record where it has actually been done.

The propriety of some other parts of this advice is also questionable, especially that relating to thrusting tubes into the cavity of the thorax. The necessity of cutting into the chelt at all in order to let out extravasated blood, in an early stage of a wound of the thorax, is positively denied by Scarpa, as we shall find from an extract we shall have to make from his work in speaking of wounds of the belly.

On the contrary, Scarpa, Larrey, Aflalin, Hennen, &c. all agree, that wounds of the chest should be closed, and superficially and lightly dressed. At all events, we may safely infer, that in these cases nothing but the urgency of the danger, unequivocally arising from the pressure of the mass of extravasated blood on the organs of respiration, can ever justify the practice of either making another opening into the chest, or of enlarging the original one. Of the method of keeping the wound open with tubes or tents, we have a very unfavourable opinion.

In every case of extravasation of blood in the chest, the discharge of it when respiration is dangerously oppressed is not the only indication. There is another one of at least equal importance: we allude to the adoption of a rigorous antiphlogistic treatment, in order to avert and diminish the dangers arising from inflammation of the pleura and lungs.

Besides extravasation of blood in the cavity of the pleura, there is another complication which sometimes attends wounds of the chest, and is particularly deferving of the attention of the practitioner. We mean the case of emphysema, or what Mr. John Bell calls “the tumour formed by air blown out from the lungs into the common cellular substance, or confined within the thorax, and oppressing the lungs.” It is not, however, our wish to detain the reader long on this interesting disorder, because by turning to the article Emphysema, we will find a statement of all the principal knowledge which exists upon the subject.

Emphysema arises from the air escaping, first from the lungs into the thorax; then from the thorax through the wound in the pleura costalis into the cellular substance on the outside of the chest; and afterwards, the air inflates the cellular membrane over the whole body. As Mr. John Bell has related, emphysema is frequent after a fractured rib, because there is a wide laceration of the lungs, and no exit for the air; while it is less frequent in large wounds with a knife or broad-barrow, because in such cases the air has an open and unimpeded issue. It is very common after deep stab with the bayonet or small-barrow; and it sometimes arises in gun-shot wounds, though, as far as our experience extends, it is not so frequent in these particular instances, as Mr. John Bell describes. Mr. Hennen thinks it does not occur in more than one case out of fifty (p. 422.), which is, perhaps, a calculation considerably below the real rate of things.

When the lungs are wounded, the air escapes from them at every inspiration into the cavity of the pleura, whence the next expiration it is compressed, and forced through the breach of continuity in the pleura into the cellular substance on the outside of the chest; for it cannot return into the wounded lung, because this is already full. Every new inspiration draws more air from the wounded lung, and every new expiration drives more air out into the cellular substance. There is no other outlet for the air, which spreads under the skin with wonderful rapidity. The emphysematous crackling tumour makes its first appearance over the broken rib, or over the wounded point of the thorax; it then extends over the whole chest, and next over the neck and face, filling particularly the eye-lids, so that the eyes are absolutely closed. It afterwards extends itself over the belly, down the thighs, and to the private parts, and no part escapes this tumour, except the palms of the hands and the soles of the feet. More air is every moment drawn out from the wound of the lungs, and driven under the skin; and the patient is every moment more and more oppressed, till at last the breathing is quite interrupted, the pulse flags, the extremities grow cold, and the patient, if he be not relieved by some operation, must die. John Bell, p. 267, 268.

The moment that the lungs are wounded, (says this author,) they fall down, and continue in this collapsed state until the wound heals, which it does in the course of a very few days; but from the moment in which lungs are wounded, the use of the wounded lobe is lost, so that if the wound be in the right side of the lungs, the breathing is performed entirely by the left; only half the quantity of air is inspired, and the breathing is difficult.

If the lungs, when wounded, were to continue in perpetu
WOUNDS.

Dural motion, (fays Mr. J. Bell,) I do not know how we should expect a cure; for the air would be continually streaming through the wound, and the wound itself alternately dilating and contracting, like that in an artery, could not heal. But as the wounded lung lies in a collapsed state, the edges of the wound are in contact with each other. P. 269.

That the lung of one side, which remains unhurt, is sufficient to support the system, we learn from various accidents; from those cases in which, either owing to the incisions made by the surgeon, or to the nature of the wound, the chest has been freely opened, the lungs of one side have collapsed, and yet the patient has lived with tolerable ease, and ultimately recovered. We learn it also from cases of emphysema, where the lungs are oppressed with air, and from cases of empyema, or pus, within the cavity of the chest, obstructing the expansion of the lungs. (See EMPHYSEMA.) And especially, (fays Mr. J. Bell,) we are sure of it from the very gradual decay of those who die with large fuppurations within the chest, in whom we find after death, that on one side there remains nothing but one small knob or tubercle of the lungs.

Koelen de Empyematie Obf. P. 135.

That the breathing should be easier in a free and open wound of the chest than in a punctured wound, or that in the case of a punctured wound the patient should be relieved by a free incision, no one need wonder; for in a punctured wound there is no way for the blood or air to escape from the thorax, while yet at every stroke of respiration, more and more blood and air is drawn out from the lungs, till at last the blood, and especially the air, are so condened, that they not only oppose that side of the lungs, but by hindering the free play of the diaphragm, and loading the mediastinum, they oppress also the other lung, the difficulty of breathing increases, the extremities grow cold, and the patient dies.

Whatever danger then depends altogether upon emphysema itself depends upon the manner in which the confinement of air in the chest oppresses not only the wounded, but also the opposite lung, the diaphragm, &c. The extensive inflation of the cellular membrane in other parts of the body is a circumstance which creates a terrible disfigurement, but perhaps very little peril in itself. Sometimes, however, it proceeds to such a pitch, that even the interstitial cellular substance of the lungs themselves becomes inflated, and then suffocation is inevitable.

On the treatment of emphysema we shall merely remark at present, that the chief means, both of relieving the organs of respiration from compription, and of hindering the further increase of the diffusion of air in the cellular membrane, consists in practising an incision in the thorax at the part where the air first escapes from that cavity. For other practical observations we refer to the article EMPHYSEMA.

The existence of adhesions between the pleura costalis and pleura pulmonalis, previously to the receipt of a wound of the chest, must make an important difference with regard to the subsequent fate of the lungs, and particularly with regard to their condition in the case of emphysema. Such adhesions must of course render a collapse of these organs impossible, and also prevent the air from infusing itself between the surface of the lungs and the infide of the chest. Whether these occurrences can be perfectly prevented will of course depend upon the extent of the adhesions. They would, however, be certainly averted altogether, were the wound to happen just at a part of the chest where the pleura costalis and pleura pulmonalis happened to be adherent.

From some remarks which have been delivered, the reader will see, that wounds opening both cavities of the chest, unless such adhesions exist, must produce immediate suffocation, in consequence of both lungs becoming collapsed. That this would really happen is the belief of the majority of the best modern writers, and that there are several facts reported which tend to confirm the accuracy of the opinion. A late author, however, conceives, that the sinking of the lung is not an uniform consequence of a penetrating wound of the thorax. He observes, that we have sometimes ocular proof of this, not only by the close contact in which the lungs lie to the wound discoverable at first sight, but by protrusions which occasionally happen. From experiments on brutes, faveshe, we derive no satisfactory elucidation; for in some, where incisions on each side have been made through the intercostal muscles, much greater than the natural passage of the air, the lungs, so far from collapsing, have expanded again, the animal has lived, and in ten days run about as well as ever. And in our own species, the recoveries from wounds of the thorax on both sides, larger than the orifice of the glottis, dangerous as they are, are not few.

Hennen’s Obf. on Military Surgery, p. 404, 405.

Wounds of the heart generally prove immediately fatal, though it is true there are to be found in the records of surgery many curious exceptions to this observation. A soldier received the thrust of a sword, which entered one of the cavities of that organ, as was ascertained after death; yet he lived nine days after the accident. (Rhodius, Obf. Medic. centur. ii. obf. 39.) A young man, twenty-six years of age, was flabb’d with a fword in the right side, between the third and fourth true ribs. He became exceedingly weak, had great difficulty of breathing, and died in four or five days. On opening the body, it was discovered that the heart had been completely transfixed, the weapon having passed from the right into the left ventricle, through the pleura. The cavity of the chest was full of blood, and it was thought that the prolongation of life had been owing to the closure of the wound with coagula. (Saviard, obf. 113.) Haller, as Mr. Hennen observes, has recorded in his Bibliotheca Chirurgica, vol. ii. p. 378, an example in which a needle was found in the heart of an ox; and through the kindness of Mr. Hammick, surgeon of the royal naval hospital at Plymouth, Mr. Hennen was lately shewn a preparation, in which a pin was lodged in the human heart, but without any trace of the mode in which it got there. The patient had complained of a pain in his chest, about three months previously to his death, and died of carditis. (Obf. on Mil. Surgery, p. 429.) Ploucquet gives instances in which a ball was lodged in the heart of a fag, in the heart of a healthy dog, and in the anterior ventricle of the human heart, where it is flated to have remained for years. Another instance has also been recently published, in which a ball was found lodged in the right ventricle of the heart, near its apex, included in a great meaurfe in the pericardium, and resting upon the septum. See the article Cas Rares, Dict. des Sciences Medicales.

Guattani mentions a case in which a patient lived eight years after a wound of the aorta (De Aneurinmatibus); and in the Medical Records and Researches, 1798, is the extraordinary case of a penetrating wound, in which a bayonet pass’d through the colon, stomach, diaphragm, part of the lungs, and the right ventricle of the heart, and yet the patient survived the accident for upwards of nine hours. Mr. Hennen also refers to another instance, related by M. Chaffenet, of a wound of the right ventricle, which did not prove fatal till the 15th day after the injury. (See Journ. de Med. Militaire, Paris, 1782, tom. ii. p. 359.) For additional observations on this subject, however, we must be content with referring to Mr. Hennen’s publication.
WOUNDS.

As wounds of the diaphragm can hardly happen without the simultaneous injury of several other important parts, these cases must necessarily be attended with considerable danger; and indeed, when the tendinous centre of the diaphragm is injured, the accident is deemed by several writers of modern date as inevitably fatal. (Laffin, Pathol. Chir. tom. ii. p. 321. Callisantes. Syll. Chir. Hodierne, Pars ii. p. 696.) The following are said to be usual symptoms of a wound of the diaphragm: —The patient is immediately seized with excessive anxiety and agitation. He feels acute pain in the hypochondrium, and is obliged to keep himself bent forwards; and he is further afflicted with a cough, hiccup, convulsive spasms, and great difficulty of breathing. Dehiscence ensues, the muscles of the face are convulsed, the anguish grows worse and worse, and the cafes terminate fatally in the course of a few days.

Dangerous, however, as wounds of the diaphragm must generally be, on account of their being for the most part complicated with injury of some of the abdominal or thoracic visceræ, there is no doubt that the danger has been exaggerated. "Wounds of the thorax (says Dr. Thomson) are not unfrequently complicated with wounds of the abdomen. In various instances of this kind (which this gentleman saw in the Netherlands after the battle of Waterloo), there existed undoubted proofs of the fact that wounds of the diaphragm are not necessarily fatal; for it must have been perforated once, if not twice, in several of the cases we have, in which balls had passed across the lower part of the chest, and the same thing must have happened also, I conceive, in most of the cases in which the liver had been wounded. In one case, the ball had entered the right hypochondriac region, under the edge of the false ribs, and come out on the right side of the spine, on a level with the superior edge of the os ilium. This patient spitted blood for some days, and voided it also by stool. On the examination after death of a patient who died thirty days after receiving the wound, and in whom a ball had entered the chest on the lower and outer part of the right papilla, and had come out of the abdomen on the left side of the umbilicus, the right lobe of the lung was found wounded, and the diaphragm and the upper part of the right lobe of the liver perforated. But neither in these cafes, nor in several others of wounds of the diaphragm which we did, did any peculiar symptoms, such as the ritis fardonicus, or convulsive motions of the chest, present themselves to our notice." See Report of Obi. made in the Mil. Hopsitals in Belgium, p. 93.

In the treatment of wounds of the diaphragm, abstrac- tedly considered, very little can be done; bleeding and antiphlogistic remedies appear the only means which promise any effectual good. With these, however, we may sometimes usefully conjoin opiates.

Extensive wounds and lacerations of the diaphragm occasionally give rise to a particular and incurable species of rupture, in which some of the abdominal visceræ form a protrusion in the cavity of the chest. This accident is termed a phrenic hernia, and some account of it will be found in the article Hernia.

Wounds of the Belly, or Abdomen.—Wounds of the abdomen are divided into two principal classes: in one the solution of continuity is confined to the integuments, muscles, &c. exterior to the peritoneum; in the other this last membrane is penetrated, and frequently some of the visceræ also which are included in it. Wounds affecting the parietes of the abdomen, but not extending through the peritoneum, whether of the punctured, incised, or contused kinds, have no essential difference from wounds of other parts, and the observations which have been offered on the subject of wounds in general are in every respect applicable to all superficial wounds of the belly. It is worthy of remark, however, that the parietes of the abdomen are always weakened in consequence of wounds, and difposed to allow the visceræ to form protrusions. Strong as the cicatrix may be, the point where it is situated continues subject to a hernia, which seldom fails to occur, unless the weakened part be properly supported with a belt or bandage. This accident may follow a simple punctured wound; but it invariably takes place in every instance where, in consequence of a severe contusion, the parietes of the abdomen have lost their tone, and yield to the impulse made against them by the parts which they contain. It was thus that a cooper's wife, whose history is given by Sennertus, after being violently struck on the abdomen by a piece of green elastic wood, which slipped out of her husband's hands, suffered such a relaxation of the contused part, that the anterior parietes of the abdomen yielded so as to form an enormous pouch, containing, during pregnancy, the gravid uterus itself.

After accomplishing the re-union of a superficial wound of the belly by means of an eligible position, adhesive plasters, and a bandage, we should therefore recommend the patient to wear a belt, or any other means of making pressure on the part which must be supported. Should the wound have been confined to the skin, however, and the muscles not have been at all divided, there would be no risk of a hernial protrusion afterwards, and of course the use of a belt, or any fort of bandage, would then be unnecessary.

If superficial wounds of the abdomen are unattended with any particular danger or peculiarity, the same observa- tion cannot be made with respect to penetrating wounds, or those which pass through the peritoneum. We have seen that penetrating wounds of the chest give rise to a variety of dangers, sometimes depending upon the effusion of blood into the bronchial and air-cells of the lungs, or into the cavity of the pleura; sometimes upon the consequences of that extraordinary complication emphysema; but more especially upon the great tendency of the pleura and lungs to inflammation. The principal dangers of penetrating wounds of the belly arise also partly from internal hemorrhage within the cavity of the peritoneum; partly from the irritation which is produced by the accidental extravasation of the contents of the visceræ; but in a still greater degree, from the strong disposition of the peritoneum to become affected with violent and extensive inflammation, in consequence of any injury or irritation. There are, says Mr. John Bell, a thousand occasions on which this delicacy of the peritoneum may be observed. The wound of the small word, and the stab of the stiletto, explain to us how quickly the peritoneum, and all its contained bowels, inflame from the most minute wound, although it be almost too small to be visible on the outside, and scarcely within; for, upon incision, no intestines are seen wounded, and no feces have escaped into the abdomen. In those who die after lithotomy, we find the cavity of the peritoneum universally inflamed. The operation of Caersean section is fatal, not from any loss of blood, for there is little bleeding, nor from exposure to the air, for they also die in whom the womb bursts, and where the air is not allowed to enter; but merely from that inflammation which succeeds to wounds of the peritoneum, small as well as great, of which we have sometimes a melancholy proof in the operation of hernia, in which the rifting the wound, according to the whimsical improvement of some modern surgeons, or where the mere tying of the fac, as in the practice of the old rupture-doctors and castrators, often raised such inflammation as spread very quickly over the abdomen, and ended in gangrene.
WOUNDS.

gene. This inflammation may, no doubt, come on from the slightest scratch in the peritoneum itself; yet, in general, it arises rather from the wound of some of the visera. If an intestine be wounded, it may pour out its feces into the abdomen; if the liver, spleen, or kidneys be wounded, these pour out blood; if the bladder, then the urine filters into the cavity of the belly. The extravasated food, feces, urine, blood, &c. act there as irritating extraneous substances, which no activity of the absorbents can remove, and which soon cause a fatal inflammation of every peritoneal surface within the abdomen. See John Bell's Difficulties on the Nature and Cure of Wounds, p. 310. edit. 3.

Apprized by melancholy experience of the vast difference which the penetration of the peritoneum makes in the nature of a wound of the abdomen, surgeons have betrayed consideruble anxiety to be able to ascertain at first, in every instance, whether the injury partakes of this serious description or not. But although the nature of the case is self-evident, when the wound in the parietes of the abdomen is large, and attended with protrusion of the visera, it is often extremely difficult to judge whether the weapon has gone through the peritoneum or not, when the wound is a simple stab, unaccompanied with protrusion of the visera, or with any effusion of their contents.

The generality of surgical authors have laid down a variety of criteria for determining the question, whether the case is a penetrating wound? Some of these writers lay much stress on comparing the direction of the wound with the natural thickness of the parietes of the abdomen at the injured part, and the breadth of the injury with that of the weapon. When the instrument has acted perpendicularly upon a point, where the parietes are thin, and the wound, though made with a narrowth weapon, like a sword, is of a certain breadth, there can indeed be little doubt of the case being a penetrating wound. But the impossibility of knowing in what direction the thrust has been made, and of procuring the weapon, in order to compare its diameter with that of the wound, generally renders this mode of discrimination useless in actual practice.

If a probe (say other writers) will readily enter perpendicularly to a certain depth, in a place where the parietes of the abdomen are thin, the circumstance is a proof that the case is a penetrating wound. But if the probe cannot be thus introduced, we are by no means justified in concluding that the wound does not penetrate. As the layers of muscles do not bear the same relative position to each other which they did at the time of the accident, they soon stop the passage of the probe; and in whatever posture we put the patient, it is next to impossible to put the parts exactly in the same position in which they were at the time of the receipt of the injury. Besides, when the wound is oblique, a probe which is not very flexible cannot easily be made to follow its track. The employment of this instrument is also not free from objections, founded on its creating pain and irritation, or even a renewal of hemorrhage and effusion of blood in the cellular membrane.

An absurd proposal has been made to inject a mucilaginous fluid into the wound, the passage of which into the belly would be a more evident indication of the cavity of the abdomen being penetrated. It is obvious, however, that the injected liquid may not enter, though the case be a penetrating wound, owing to the change in the relative position of the layers of the abdominal muscles. The fluid may also continue in the wound in consequence of its passing into the cellular substance; and thus it may make the surgeon suppose that it enters the abdomen, when in reality it does not pass down even to the peritoneum. Nor can the mildest injection be thus thrown into the cavity of the peritoneum without the utmost risk of exciting that fatal kind of inflammation which we have already mentioned, as the danger most to be dreaded in all wounds of the abdomen.

The signs then of a penetrating wound of the abdomen are fallacious, and the employment of such means as the probe and injections, with a view of ascertaining the real nature of the case, is not exempt from danger. Many spasmodic affections, which occasionally follow the receipt of a wound of the belly, are only equivocal, as they are sometimes owing entirely to the great sensibility of the patient. The protrusion of the abdominal visera, and the discharge of fluids which they are known to contain, are the only sure signs of a penetrating wound. It is easily conceivable at the same time, that a wound may penetrate the cavity of the belly, and yet these symptoms may not occur, either because the external wound is too small to allow of the escape of any of the visera or their contents, or because the weapon or ball, after piercing the peritoneum, has actually touched none of the bowels, or has merely glided over their surface. But penetrating wounds, which are unattended with protrusion of the visera, or extravasation of any fluid in the cavity of the abdomen, are less alarming than several complicated wounds which do not penetrate. If in such case, says Richerand, the patient or bystanders were to inquire about the nature of the injury, we should avoid giving a positive opinion, informing them of the insufficiency of the means formerly practised, in order to ascertain the precise depth of the wound, and explaining the objections to the probe and injections. It should also be mentioned to them that the antiphlogistic treatment, which is the belt in simple wounds which do not penetrate, is the only plan which could be adopted, were it certain that the injury had extended into the cavity of the abdomen. Nefographic Chir. tom. iii. p. 327–335. edit. 4.

In the following description of the treatment requisite for the different cases of penetrating wounds of the belly, we shall follow the order chosen by M. Richerand, and consider,

First, the cases in which the visera, though uninjured, protrude at the wound.

Secondly, the cases which are complicated both with injury and protrusion of the visera.

Thirdly, penetrating wounds unaccompanied with protrusion, but yet attended with injury of one or more of the visera, as is indicated by particular symptoms, and especially by the issue of certain kinds of matter from the external wound.

And lastly, we shall conclude with noticing the subject of extravasations, and some wounds of particular organs and visera.

1. Of Wounds of the Belly, attended with Protrusion of the Visera.—When, in consequence of a division of the parietes of the abdomen by a cutting instrument, or their laceration by a bull's-horn, the intestines protrude between the lips of the wound, the first indication is to reduce the parts, and then to take measures for preventing a recurrence of the protrusion. The reduction is generally easy, if care be taken to relax the abdominal muscles by a judicious posture. In some cases, however, the wound is so narrow that the thing is more difficult, and here, instead of puncturing the bowel, in order to diminish its size by discharging the air which it contains, (as advised by many writers,) we decidedly recommend a moderate enlargement of the wound. This should be cautiously executed with a probe-pointed curved biliony, introduced along the groove of a director; or, if there be room, under the guidance of the left fore-finger.
finger. In this manner, and with due care, the wound may always be sufficiently dilated without the protruded parts being cut. Authors also recommend the incision for this purpose to be directed upwards; for (say they) the further the cut is from the lower part of the belly, the less liable will the patient afterwards be to hernia. The intestines should invariably be returned without delay, in every instance in which they are free from wound or gangrene. Should they even be slightly wounded or inflamed, no time should be lost in applying fomentations, &c., to them in their protruded state. The natural warmth and moisture of the cavity, into which they are to be replaced, will be far more congenial than any topical remedies. Should the parts, however, have any dirt or sand upon them, the Moff which ought to be done before their reduction is to wash them with warm milk and water.

The reduction having been effected, the patient is to lie upon his back, with the thighs bent upon the pelvis, and he must strictly avoid making any exertion, till it bring on another protrusion. The wound is to be closed with adhesive plaster, and the uniting bandage; but if the wound should be large, and these means ineffectual, it would also be proper to employ sutures. The stitches, however, should always be as few as possible. This method of sewing up wounds of the belly made a long subject in all the old works on surgery, under the appellation of Gastroraphy (see that article); but at the present day, sutures are comparatively speaking almost rejected from practice, or are only employed when the opposite surfaces of wounds cannot be kept in contact without them. Nor are they then ever used, except the chance of union by the first intention still forms a temptation for the trial of the plan; for when a wound must heal by the granulating process, stitches can never be of the least utility.

When the omentum protrudes through a penetrating wound, and is frangulated by the narrowness of the opening, it soon contracts adhesion. Richerand recommends us to cut off all this membrane which exceeds the level of the integuments, and to leave in the wound the rent, which, he affirms, will act like a stopper, and hinder future hernia. Were the wound, however, quite recent, so that adhesions could not yet have formed, the propriety of dilating the opening, and reducing the piece of omentum, could be unquestionable. Whenever, also, the omentum is found, and free from constriction, it should be reduced. In cases where a portion of this membrane is not only protruded, but gangrenous, writers authorize the excision of the dead part, and reducing the rent after the cut vessels have been tied firmly with small silk ligatures. We apprehend, however, that in general, whenever the omentum has been out for as long as to slough, adhesions within the wound have had time to form; an event which would embarrass the operator, and even render the safety and propriety of the attempt to reduce the living portion of the protruded membrane very questionable. Should the omentum, or intestine, however, be not adherent to the neck of the hernial sac, though gangrenous, (as occurred in an instance cited by Scarpis, Trait de Hernies, p. 268,) the propriety of trying to reduce it would be undeniable.

2. Wounds of the Belly, with Injury and Protrusion of the Viscera.—Penetrating wounds of the abdomen, attended with protrusion of the intestines, are always to be regarded as dangerous cases; but the danger is much more serious, if, besides being protruded, the bowels are also wounded. Under such circumstances, we have the authority of numerous writers on surgery, as a function of the practice of sewing together the edges of the division in the protruded intestines; a practice, however, which, as we shall hereafter explain, does not meet with the approbation of that excellent modern surgeon, professor Scarpis, of Pavia. Every one, however, allows, that the attempt would be highly improper and rash, were the bowel only wounded, without forming a protrusion. It is this last occurrence which creates a material difference in estimating the possibility of the plan, the question of its necessity being at present excluded from consideration. When the parts are protruded, no enlargement of the external wound is necessary to render the application of a future practicable; the plan creates no disturbance and irritation of the peritoneum and contiguous visceras; there is no doubt concerning the actual existence of the injury, no difficulty in immediately finding out its precise situation.

But though many authors are so generally agreed about the propriety of using a future in the case of a wounded and protruded bowel, they differ exceedingly, both as to the right object of the method, and the most advantageous mode of making the stitches. Some, having little apprehension of extravasation after the reduction of the gut, advise only one stitch to be made, (frequently only through the mesentery,) and they employ the ligature chiefly with a view of confining the injured bowel near the external wound, so that whatever part of its contents may be effused, there will be a ready passage for the matter outward. Other writers wish to remove the possibility of extravasation, by applying numerous stitches, and attach little importance to the plan of using the ligature, principally for the purpose of keeping the intestine near the external wound.

When the wound of a bowel is so small that it is closed by the protrusion of the villous coat, the application of a future must evidently be altogether needless; and since the ligature could not fail to cause irritation, as an extraneous substance, the employment of it ought unquestionably to be dispensed with.

Supposing, however, the breach in the intestine to be small, but yet sufficient to let the feces escape, what method ought to be adopted? The following practice has been tried. As Mr. A. Cooper was performing the operation for an strangulated hernia, at Guy's hospital, an aperture, giving issue to the intestinal contents, was discovered in a portion of the found bowel, just when the part was about to be reduced. The operator, including the aperture in his forceps, caused a fine silk ligature to be carried beneath the point of the instrument, firmly tied upon the gut, and the ends cut off close to the intestine. The part was then replaced, and the patient did well. Mr. Travers, who has related this fact, approves of the plan of cutting away the extremities of the ligature, instead of leaving them hanging out of the external wound. It appears that when the first practice is followed, the remnant always finds its way into the intestine, and is discharged with the stools, without any inconvenience. But when the long ends are drawn through the outer wound, and left in it, they materially retard the process of healing. See Travers's Inquiry into the Proofs of Nature in repairing Injuries of the Intestines, &c., p. 112, 113.

Let us now inquire what ought to be the conduct of a surgeon, were he called to a patient, whose bowel is divided through its whole diameter, and protruded at the external wound? Various have been the schemes and proposals for the treatment of this fort of accident; and since experience has furnished few practitioners with an opportunity of seeing such a case in the human subject, a variety of experiments have been made on animals, in order to determine what treatment would be the most successful. Ramdohr, indeed,
WOUNDS.

is rated by Mœbius to have had occasion to try on the human subject a plan, on which a vast deal has been paid and written. He cut off a large part of a mortified intestine, and joined the two ends together, by inferring the upper within the lower one, and fixing them in this position with a future; the ligature being also employed, to keep them at the same time near the external wound. The patient recovered, and the feces afterwards passed entirely by the rectum in the natural way. See Halleri Difputat. Anat. vol. vi. Obf. Med. Miscellan. 18.

About a year after the operation, the patient died, when the anatomical preparation of the parts was sent by Ram- dolar to Heister. They were preferred in spirits of wine, and exhibited, according to this last author, an union of the two ends of the bowels together, and their conflation with a part of the abdomen. Now it has been questioned by a late writer, whether the union here spoken of ever really happened. When the upper end of the bowel is intro- duced into the lower, the external surface of the former is put in contact with the inner one of the latter; a serous membrane is placed in contact with a mucous one. These heterogeneous membranes, he alleges, are not disposed to unite. The mucous membrane, when inflamed, more readily secretes a kind of mucus, which must be an invincible ob- stacle to adhesion. He thinks it, therefore, more probable, that, in the case related by Heister, the invagination was maintained by the union of the intestine with the corresponding part of the abdominal parietes. Several ex- periments on living animals have convinced him that this happens, and that the mucous membrane will not unite with the external peritoneal coat. This impossibility of pro- ducing an immediate union between mucous and serous membranes may, of course, be urged as an objection to Ramdolar's practice. (Richtander, Nofographie Chirurg. tom. iii. p. 344. edit. 4.) Another equally strong objection is, that the upper end of the bowel cannot be put into the lower one, unless it be separated from a part of the me- fentery. Here the division of the mesenteric arteries may cause a dangerous bleeding. In vain did Boyer tie seven, or eight of these vessels: his patient died with an extravasation in the abdomen. (Op. cit. tom. iii. p. 343.) Mœbius attempted to repeat Ramdolar's operation on a dog; but he could not succeed in inferring the upper part of the divided bowel into the lower one, on account of the contraction of the two ends of the intestinal tube, and the smallness of the canal. Mœbius was, therefore, obliged to be content with merely bringing the ends of the bowel together with a future: the animal died, however, of an extravasation of the feces.

Dr. Smith, of the Philadelphia Medical Society, also tried to repeat Ramdolar's method; but could not succeed. He divided the small intestine of a dog transversely, and having inferted a piece of candle into that portion of the bowel which was supposed to be uppermost, he endeavoured to introduce the superior within the inferior; but the ends became so inverted, that it was found utterly impossibile to succeed. The scheme was, therefore, given up, and only one stitch made, the ligature being then attached to the external wound, in the manner advised by Mr. John Bell. The dog died, and on examination there was found a considerable quantity of feces and water in the abdominal cavity.

Two more trials were made by Mr. John Bell's plan by Dr. Smith, on the intestines of dogs: in both instances the animals died, the intestines being much inflamed, and feces effused in the abdomen. See Dr. Smith's Thesis.

Mr. Travers likewise tried the same experiment. "I divided the small intestine of a dog, which had been for some hours falling, and carried a fine stitch through the everted edges, at the point opposite to their connection with the mesentery. The gut was then allowed to slip back, and the wound was closed. The animal survived only a few hours.—Examination. The peritoneum appeared highly inflamed. Adhesions were formed among the neighbouring folds, and lymph was deposited in maffes upon the sides of the wounded gut. This prefented two large circular orifices. Among the viscera were found a quantity of billious fluid, and fome extraneous substances, and a worm was depending from one of the apertures. By the artificial connection of the edges in a single point of their circumferencce, and their natural connection at the mefiency, they could recede only in the intervals, and here they had receded to the utmost." In another experiment, Mr. Travers increafed the number of points of contact, by placing three fingle stitches upon a divided intestine, cutting away the threads, and returning the gut. The animal died on the second day.—Examination. Similar marks of inflammation prefented themselves. The omentum was partially wrapped about the wound; but one of the spaces between the futures was uncovered, and from this the intestinal fluids had escaped. On cautiously raising the adhering omentum, the remaining stitches came into view. Here again the retraftion was confiderable, and the intervening elliptical aperture proportionally large. On the side next to the peritoneum, however, the edges were in contact, and adhered, fo as to unite the fictions at an angle.

From such experiments, the conclusion drawn by Mr. Travers is, that appofition at a point or points is, as respects effusion, more disadvantageous than no appofition at all; for it admits of retraftion, and prevents contraction, fo that each stitch becomes the extremity of an aperture, the area of which is determined by the distance of the stitches. (P. 116. 119.) This gentleman, therefore, maintains, that the absolute contact of the everted surfaces of a divided intestine, in their entire circumferencce, is requisite to secure the animal from the danger of abdominal effusion. (P. 121.) The species of future employed, says Mr. Travers, is of secondary importance, if it secures this contact. (P. 134.) And, among other obfervations, we find, "wounds amounting to a direct division of the canal are irreparable, and, therefore, irrevocably fatal." P. 133.

In the Dictionarv of Praplitical Surgery will be found several reasons for not entirely agreeing with these conclusions. We cannot admit that a total division of the intes- nal tube is certainly and invariably fatal, because we must not only difbelieve the mode of union in Ramdolar's cafe, which we undoubtedly do, but we must also disbelieve the refult of that cafe, and of some others which we would cite, were this a publication expressly allotted to surgery. Nor are we at all convinced of the utility of applying nu- merous stitches to a divided bowel, in order to keep the edges of the wound together. Were a cafe to prefent itself to us, in which a bowel was protruded, and partly cut through, we should at moft apply only a fingle future, made with a common fewing-needle, and some fine filk, and even of the safety and utility of a fingle future, we entertain doubts. If the bowel were completely cut across, we would also attach its ends together merely by one stitch of the fame kind; and we should do fo without feeling at all affured that the practice of a future would be at all right. We perfectly coincide, however, with Mr. Travers respecting the advantage of cutting off the ends of the ligature, instead of leaving them in the wound, as we believe he is right in regard to the little chance there is of the injured in-
WOUNDS.

teffine receding far from the wound; and if the ends of the ligature are then of no use in keeping the bowel in this position, they must be objectionable as extraneous substantes. Dëct. of Præd. Surgery, edit. 3. art. Wounds.

The following is the process by which, according to Mr. Travers, a divided intestine is healed, when futures are employed: "It commences with the agglutination of the contiguous mucous surfaces, probably by the exudation of a fluid, similar to that which glues together the sides of a recent flesh wound, when supported in contact. The adhesive inflammation is afterwards, and binds down the everted edges of the peritoneal coat, from the whole circumference of which a layer of coagulable lymph is effused, so as to envelope the wounded bowel. The action of the longitudinal fibres being opposed to the artificial connection, the sections mutually recede, as the future bones, by the process of ulcerative absorption. During this time, the lymph deposited becomes organized, by which further retraction is prevented, and the original cylinder, with the threads attached to it, is encompassed by the new tunics.

"The gut ulcerates at the points of the ligatures, and these fall into its canal. The fissures left by the ligatures are gradually healed up; but the exposed villous surfaces, so far as my observation goes, neither adhere nor become consolidated by granulation, so that the intestine, making the division internally, is probably never obliterated." Travers on Injuries of the Intestine, &c. pp. 52.

The celebrated Scarpa published, a few years ago, some highly interesting remarks on the process employed by nature in repairing solutions of continuity in the intestinal canal, especially in cases of hernia with gangrene; and the results of his investigations are also both curious and instructive, in relation to what happens, and what ought to be done, in wounds of the abdomen. (Sull'epico Memorie Anatomico-Chirurgiche, &c. Milano, 1809.) He observes, that the leafy fatal consequence of a mortification of the bowel is the escape of the excrement through the wound, or artificial anus; an afflicting and disgusting infirmity, but one which does not preclude all hope of a radical cure, even though a considerable portion of the intestinal canal may have been destroyed by phæulesis. The recorded examples of such cases are abundant, and yet, says Scarpa, nothing has yet been written which will serve to convey an exact idea of the simple and admirable means which nature employs in accomplishing them. Surgeons generally suppose, that after the detachment of the dead parts, the two orifices of the bowel remain gaping, and acquire adhesion to the margins of the external wound; that afterwards, in proportion as this contracts, they come gradually nearer together, and in the end touch each other so accurately, that the feaces are capable of paffing directly from the superior into the inferior portion of the gut. But this theory cannot satisfy those who have attentively examined, in some cases of mortified hernia, the respective situation of the two orifices of the intestine, and their relation to the external wound. In fact, the twò ends of the bowel are constantly found lying in a parallel manner by the side of each other; the upper with its orifice open, and directed towards the external wound by the feaces which issue from it; the lower, on the contrary, as it gives passage to nothing, always has a tendency to become less capacious, and retracted into the cavity of the abdomen. The contraction of the external wound cannot have the least effect in changing the direction of these two orifices, nor conseqently in applying them to each other. Even supposing there were some natural tendency to this approximation, the upper orifice, being wider than in the natural state, and directed outwards, could never accurately coalesce with the lower one, which is shrunk, and retracted within the belly. The feaces then could never pass from one into the other without the effusion of a large part of them outwardly, and an incurable fistula, discharging the intestinal contents, would in every instance be the consequence.

Scarpa had an opportunity of examining the body of a young man, who, in consequence of eating a large quantity of indigestible food, died about ten months after having been operated upon for a congenital hernia, attended with mortification of the protruded bowels, at a period when he had recovered, with the exception of an occasional discharge of a very small quantity of feaces from an incon siderable fistulous opening. He also diffected two other cases. From all these it appears, that the breach in the intestinal canal is not repaired by the orifices of the upper and lower portions of the bowel re-uniting, coalescing, and running as it were into each other; nay, that they meet at a very acute angle, the axis of one not corresponding with that of the other, and they never lie laterally together.

On the contrary, Scarpa's investigations satisfactorily prove, that a funnel-shaped membranous canal (what he terms the imbuto membrano), composed of the remains of the hernial fac, constitutes the medium of communication between the upper and lower orifices of the bowel, which, in an early stage of the disease, becomes adherent to the peritoneum about the neck of the hernial fac. The base of the funnel-shaped membranous cavity corresponds to the bowel, and its apex tends towards the wound or fistula. It further appears, that the feces, in order to get from the upper into the lower part of the bowel, have to pass through the funnel-shaped cavity in quite a semicircular track, and that between the orifices of the bowel, directly opposite to the aperture between the cavity of the intestine and that of the funnel-shaped mem branous, a consideraby projection or jetting angle is formed, which makes a material additional obstacle to the direct passage of the feces, from the upper into the lower portion of the intestinal tube.

Scarpa thus explains the formation of the funnel-shaped membranous cavity, that constitutes the channel of communication between one part of the bowel and the other:

The hernial fac, as every surgeon knows, does not always partake of gangrene with the visera contained in a hernia: and even when it does slough, since the separation of the dead parts happens on the outside of the abdominal ring, there almost always remains in this situation a portion of the neck of the hernial fac perfectly found. We may say, therefore, that in all cases immediately after the detachment of the mortified intestine, whether it happen within or on the outside of the ring, the two orifices of the gut are enveloped in the neck of the hernial fac, which soon becoming adherent to them by the effect of inflammation, serves for a certain time to direct the feces towards the external wound, and to prevent their effusion in the abdomen. In proportion as the outer wound diminishes, the external portion of the neck of the hernial fac also contracts; but that part which embraces the orifices of the intestine gradually becomes larger, and at length forms a kind of membranous funnel or intermediate cavity, which makes the communication between the two parts of the bowel. This adhesion of the neck of the hernial fac round the two orifices of the gut does not hinder the latter from gradually quitting the ring, and becoming more and more deeply placed in the cavity of the abdomen. Scarpa then cautions surgeons not to fancy from this account, that there is any occasion to pass a ligature through the mefentery for the purpose of fixing it near the ring; even were the gangrenous
grosenous bowel perfectly free and inadherent to the neighboring parts. The truth is, that the adhesive inflammation, which also commences immediately after the operation, fixes the parts near the wound before they can be drawn away by any retraction of the bowel or mesentery; and in the course of the first 24 hours the two orifices of the divided intestines are constantly enveloped in the remains of the hernial fac. In a case of this kind, where the mortified bowel was not at all adherent to the neck of the hernial fac, Scarpa introduced a ligature through the mesentery in the usual way, and on withdrawing it at the end of 24 hours, and passing his finger to the bottom of the wound, he found the circumference of the two orifices of the bowel every where adherent. When a ligature through the mesentery had not been practised, and no effusion, he also invariably discovered the bowel adherent to the neck of the hernial fac, in every subject who had died soon after the operation for a strangulated hernia, complicated with gangrene, and whom he examined after death. Certainly, he observes, it must be allowed that the orifices of the divided intestines do retract, and become farther from the ring; but they do so very slowly, and always draw along with them the neck of the hernial fac to which they contract early adhesions.

Our limits oblige us to pass over many other interesting observations relative to the cauæ which facilitate or retard the re-establishment of the continuity of the intestinal canal, and on the necessity of the funnel-shaped membrane as a substitute for the portion of bowel destroyed by gangrene. We shall next notice the comparison of the artificial anus, arising from a mortified hernia, with that which is the result of a penetrating wound of the abdomen, as made by the intelligent Scarpa. "Why," he inquires, "is it so common to see the continuity of the intestinal canal re-established after a mortified inguinal or crural hernia, while the artificial anus is always incurable, when it is formed in consequence of a penetrating wound of the abdomen with protrusion of the intestine, whether a part of the canal be destroyed by gangrene, as in the instance related by Mofcati (Mém. de l'Acad. de Chir. t. 8.), or whether it be totally or partially divided by the wounding instrument, as in the examples recorded by Stalpart-Wander Wiel (Obf. Rar. t. ii. obf. 25.), Cabrol (Opér. Med. obf. 13.), Fabricius Hildanus (Centur. i. obf. 74.), &c.?" Scarpa will not even allow as an exception to this remark the case recited in the 2d vol. of the Œuvres Chir. de D e f a u l t ; because he conceives the details are not sufficiently explicit.

In order to resolve this problem, says he, we have only to compare a wound of the belly complicated with protrusion and mortification of the bowel, with a mortified intestinal hernia, and draw a parallel between the circumstances which accompany the two cases, and constitute their chief differences. 1st. In a hernia, the two extremities of the mortified gut are always enveloped in the remains of the hernial fac, which form in front of the two orifices a kind of funnel-shaped canal. There is nothing like this at the extremities of a bowel divided either by a cutting instrument which has penetrated the abdomen, or by mortification, which has complicated a wound of this description. 2dly. In the last instances, the wounded or burst intestine becomes adherent to the edges of the external wound; consequently, it cannot retract into the abdomen, and the feces, which descend out of the upper portion, being as it were on a level with the skin, must necessarily all escape out of the external wound. This is precisely what actually happens, it being known that artificial ani of this kind are always incurable. After a mortified hernia, on the contrary, it is upon the facility with which the bowel becomes situated farther from the wound, drawing along with it the remains of the hernial fac, that the formation of an intermediate cavity between the two orifices of the gut depends, and which is to make the communication between them. What happens after penetrating wounds of the belly, with injury of the bowels, is also seen in ventral hernias, which have formed under the cicatrix of a long-cured wound of the abdomen, when such hernias are unfortunately attacked by mortification. Large, old, umbilical, and ventral hernia, though furnished with a hernial fac, generally give rise to incurable artificial ani whenever they are put.

It follows, says Scarpa, from the foregoing and other facts, that the retraction of the neck of the hernial fac, and of the two orifices of the bowel, is essential to the re-establishment of the continuity of the intestinal canal, which has been made in it by mortification. Hence, he thinks, that in future every body will consider the plan of passing a ligature through the mesentery, in order to keep the two ends of the gut near the outer wound, not only as useless, but even as dangerous. The adhesions of the neck of the hernial fac to the intestine, before the occurrence of gangrene, must almost always render the ligature useless. And even when the adhesion does not exist at the period of cutting through the floughs, Scarpa affirms that the ligature is equally unnecessary. Indeed, says he immediately after, the operation, while nature effecting the separation of the dead from the living parts, the latter invariably contract, in a very short time, close adhesions to the neck of the hernial fac, either on a level with a ring, or a little within it, and there is no danger of the feces being extravasated in the abdomen. If the latter accident has sometimes happened in subjects who have died of hernia with gangrene in a few days, it has been because the feces could not make their way outward quick enough, and therefore occasioned a bursting of the bowel in the abdomen, within the ring and beyond the extent of the hernial fac. If, in some other cases, the two orifices of the bowel have been found in the dead subject not adherent to the neck of the hernial fac, and the feces extravasated, Scarpa thinks it has happened only after death, when the relaxation of the whole abdomen has let the ends of the bowel quit the neck of the hernial fac, to which it had not yet acquired any adhesions. But he conceives that nothing like this can ever happen in the living body, owing to the alternate action of the diaphragm and abdominal muscles, which compels all the visceral, and tend to propel them outward.

Hippocrates writes, "Si quod intellinorum gracilium ficdicitur, non coalescit." (Sect. 4. Aphor. 24.) This aphorism, says Scarpa, taken in its true sense, is the expression of an incontestible fact. It is very true, that wounds of the intestinal canal follow in their cicatrization quite a different course from simple wounds of the skin, mucous, or any other parts of the body. Their edges are never observed to become immediately applied to each other, and therefore, strictly speaking, they do not unite. Their cure is altogether completed through the medium of the surrounding parts; that is to say, by the adhesions which the intestines contract with the great fac of the peritoneum lining the parietes of the abdomen, or with the productions of this membrane which compose the external covering.
covering of the greater part of the viscéra. Littre relates, that a lunatic flabb'd himself with a knife in eighteen places about the abdomen, eight of which wounds penetrated into this cavity, and evidently injured the bowels. The man, however, recovered in two months; but in another paroxysm of mania he threw himself out of the window, and was killed. On opening his body, all the cicatrizes of the intestinal canal were found adherent to some point of the surface of the adjacent viscéra or parietes of the abdomen. There was not a single one which seemed to be formed by the direct contact of the edges of the intestinal wound with each other. Acad. Roy. des Sciences de Paris, 1705.

The peritoneum, when irritated by any cause whatsoever, has a singular disposition to inflame round the point of irritation, and to contract adhesions with the parts which are contiguous to it in the same situation. Thus, when one or several convolutions of intestines have been divided by a cutting instrument, or pierced by a ball, they always become united for a certain extent to the surrounding parts, all of which are covered with the peritoneum. (See also Plutner's Inst. Chir. § 694.) These adhesions, which are the only means employed by nature for blocking up accidental openings in the intestinal canal, are promoted by the pressure which the abdominal muscles and diaphragm alternately make upon the viscéra in the actions of inspiration and expiration.

In a subsequent part of his work, Scarpa delivers his own sentiments on the different plans which have been proposed for effecting the reunion of a divided intestine. If, says he, we compare Ramdohr's operation with the simple and effectual processes employed by nature for re-establishing the continuity of the intestinal canal after hernia with mortification, we are compelled to acknowledge on this point, as well as on many others, that art continues very inferior to nature.

In the first place, says Scarpa, the introduction of one part of the bowel into the other is impracticable in a great many cases of mortified hernia, in consequence of the adhesions which the sound part of the intestine has contracted with the neck of the hernial sac, during the inflammatory period of the strangulation. Secondly, it is hardly ever possible, without inconvenience, to draw a considerable portion of the intestinal canal out of the belly, for the purpose of introducing, with all the requisite precautions, the upper end of the bowel into the lower. This cannot be done without handling for too long a time, and more or less roughly, the bowel, which is already irritated; which circumstance, together with the pricks of the needle, and the dragging of the stitches, is more than an adequate cause for the production of a fatal inflammation. The danger will be still farther increased, if, according to the experiments of some modern surgeons, the two ends of the bowel are fewed together over a piece of a calf's trachea, or a small hollow cylinder of tallow, or filings, a pasteboard tube, &c. Whatever may be the foreign body put within the bowel, it may, by obstructing the course of the feces, bring on violent inflammatory symptoms, and destroy the patient in the most agonizing fursuages.

Scarpa then adverts to the experiments made on dogs by Dr. Thomson of Edinburgh, and Dr. Smith of Philadelphia, which tend to prove that the two extremities of a divided bowel may be united by means of a future, and then returned into the cavity of the belly, without endangering the animal's life. (See also Boyer's experiments on this subject, in the Mém. de la Société de Médecine de Paris, tom.i.) It is alleged (says Scarpa), that there is no risk of the ligatures falling into the cavity of the abdomen after their detachment; but that by one of the operations of nature which cannot be explained, the threads are voided with the feces after the cure. Scarpa notices that the particulars of the way in which these futures were made is not given; and how (says he) have the above gentlemen succeeded in applying the orifices of the divided bowel accurately to each other, which is extremely difficult, especially in dogs? In whatever light the subject is viewed (he observes), "I doubt whether it is possible to reunite, by means of any future, the extremities of a divided bowel after mortification in hernia, or at least to do it with any probability of success. Such experiments, even when they succeed in the best possible manner, merely prove that certain operations, which would most frequently be useless or fatal on man, may be successfully practised on other animals."

On the contrary (says Scarpa), in the circumstances which have been supposed, nature is daily observed to succeed in re-establishing the continuity of the intestinal canal, by means equally simple and mild. She prepares herself (as it were,) for this work before gangrene actually takes place, by forming adhesions between the strangulated bowel and the neck of the hernial sac. After the separation of the mortified parts, she draws back into the abdomen the extremities of the divided bowel, and out of the remains of the hernial sac, she forms a sort of funnel-shaped membrane, which serves at first for directing the feces outwards, and afterwards for transmitting them from the upper orifice of the intestine into the lower, by making them follow a semicircular track from before backwards. For two or three instances of the complete success of Ramdohr's operation, an almost innumerable multitude of cures effected altogether by the powers of nature could now be cited. Thus, says Scarpa, in the present state of our knowledge, we should congratulate patients who, in these unfortunate circumstances, fall into the hands of surgeons either incapable of undertaking an operation, or little licentious about healing up the wound.

It may perhaps be imagined (continues Scarpa), that Ramdohr's operation is better calculated for certain cases of penetrating wounds of the abdomen, as, for instance, where the intestine has been completely divided with a cutting instrument, or by the effects of gangrene arising from long exposure to the air. Scarpa here allows that it would be very desirable to find out some operation which could be useful in these circumstances, which are the more unfortunate, because they do not furnish nature with the means of re-establishing the continuity of the intestinal canal, as in cases of mortified hernia. But he doubts whether in such instances Ramdohr's operation could be undertaken with any probability of success; for the complete division of the intestine is almost always the result of an enormous wound, which having interested several viscéra leaves little or no hope of recovery. Supposing the bowel should not have been divided with the cutting instrument, but that it is protruded and gangrenous from long exposure, it must be remembered, that in this case it will have contracted adhesions to the lips of the wound, even before the separation of the mortified part; consequently, the bowel cannot be drawn farther out of the belly, so as to allow one end of it being introduced into the other. To undertake such an operation then, would be to expose the patient to much greater perils than that of an incurable artificial anus.

According to Scarpa, it is little to have proved that Ramdohr's operation is impracticable when the intestine has been completely divided; he proceeds farther, and has no hesitation in affirming, that in all cases of penetrating wounds of
of the abdomen, attended with injury of the intestines, whether
the canal be opened longitudinally or transversely, a future is
always an operation not merely ineffective, but even dangerous
and fatal. In whatever manner it is practised, one cannot avoid
the evils which must originate from the punctures, however
few, and from the passage of the ligatures through the coats
of the intestine; a part ended with exquisite sensibility, and
whose external tunic is much disposed to inflame, and
rapidly to communicate the inflammation to all the other
abdominal viscera. It has been unfortunately proved, by
the experience of several ages, that in most of the cases in
which the intestine has been flushed in penetrating wounds of the
abdomen, the patients have died in the greatest agony. If a
few have escaped the dangers of this operation, it has been
because in them the flitches soon cut their way out, and
were voided with the feces which continued to escape from
the wound until it was entirely healed.

All surgeons of experience, and particularly those
of large hospitals, have often seen wounds of the right or left
flap region accompanied with injury of the great intestine.
They may also have noticed, in these examples, that after
the subsidence of the local and general inflammatory symp-
toms, the wound still continues to discharge the feces for a
certain time; but that afterwards it contracts, and the
excrement resumes its usual course. These wounds almost
always heal completely: first, because the adhesion of the
large intestine to the parietes of the abdomen prevents the
feces from being extravasated in the cavity of the peri-
toneum; and secondly, because the ample capacity of the
fame bowel always prevents a ready passage for the feces,
notwithstanding the progreffive and sometimes quick closure
of the external opening.

If, in the infancy of a penetrating wound of the belly
attended with a wound of the small intestines, it were in the
surgeon's power (as indeed it is) to return the bowel into
the abdomen, so that the opening in it may exactly cor-
respond with the wound in the abdominal parietes, there could
not be a doubt of its quickly acquiring adhesions to the
peritoneum, which lines the part around the internal orifice
of the external wound; hence the feces would readily escape through the outer wound, and at length it would
happen, after a certain time, as in wounds of the large in-
testines, that the artificial anus would gradually close up,
and the feces resume their natural track. The narrow di-
amer of the small intestines would not make an infamour-
ous obstacle to the passage of the feces, provided they be,
as they usually are in this portion of the intestinal canal,
sufficiently fluid; and besides (says Scarpa) it is not proved
by experience, that they resume their natural course, after
the cure of an artificial anus, even when a considerable
noose of the small intestines has been destroyed by gangrene,
and when the two ends form by their re-union a very acute
angle? In all cases, the patient's life would be saved, and
the worst that could happen would be his being afflicted
the rest of his days with a fistula discharging feces.

Encouraged by these principles, which are the natural
deductions of a comparison of wounds of the large intestines
with those of the small ones, Scarpa feels no hesitation
in admitting the possibility of curing the latter, without
having recourse to a future. He observes, that it would
not be difficult for him to quote examples of such cures.
Amongst others, he has lately seen one which deserves to be
mentioned here. A portion of small intestine, protruded
through a penetrating wound of the abdomen, happened to
be punctured with a bodkin by a country surgeon, in his
efforts to return the part into the belly. The feces,
however, were not extravasated in the cavity of the peri-
toneum, but were for a long while discharged through the
wound. The opening in the bowel always corresponded
exactly to that in the parietes of the abdomen, although no
future was practised, nor any ligature put through the me-
fentery in order to keep it in this situation. The feces
afterwards gradually resumed their natural course, the wound
at the same time became smaller, and in the end healed up.

The young man, the subject of this case, now enjoys very
good health, and suffers no inconvenience which can juf-
tify a suspicion of any obstruction in the passage of the feces.

The inceffant pressure made by the abdominal muscles
and diaphragm upon all the viscera, is a cause why the
wounded intestine, instead of quitting the external wound,
enters it, and contracts adhesions to its lips. If, however,
a too timorous surgeon were afraid of entirely trifling, on
this point, to the wife providence of nature, he might
(Scarpa thinks) without inconvenience pass a ligature
through the mesentery, behind the portion of wounded
bowl, as is usually and quite unnecessarily done in cases of
mortified hernia. Forty-eight hours, or thereabouts, would
be time enough for the intestine to contract adhesions,
through the medium of the peritoneum, to the inner edges of
the wound. After this period, the ligature would be
completely useless, and it ought to be withdrawn, as
there would now be no chance of extravasation of the feces in
the belly. At the same time one should neglect no remedies,
internal as well as external, which may be of use in moder-
rating the patient's sufferings, diminishing the energy of the
circulation, and bringing the inflammation down to the de-
gree requisite for the formation of adhesions. One ought
also to keep open the external wound with the same precau-
tions, and according to the same indications which are to be
attended to in the treatment of an artificial anus. The
principal object of these precautions is, to let the treatment
be such that the wound may only diminish in proportion as
the evacuation from the lower part of the intestinal canal
increases.

Here it may be à propos to observe, that the conduct of
a surgeon in the treatment of penetrating wounds of the
abdomen, attended with injury of the small intestines, is
exactly the reverse of what it ought to be in the treatment
of penetrating wounds of the chest, accompanied with injury
of the lungs.

In the latter, says Scarpa, physiology, agreeing with ex-
perience, teaches us that no means should be omitted for
effecting the immediate union of the wound, (as it is termed,
by the first intention,) care being taken to check the force
of the circulation by repeated bleedings and every antiphlo-
gitic remedy, in order to prevent or diminish, as much as
possible, internal hemorrhage. If, notwithstanding all these
means, blood should be extravasated between the pleura
and lungs, it presses equally upon every point of these vis-
cera, refits their motion, and thereby contributes to stop
the bleeding. If, after the wound in the lungs is healed,
the extravasated blood be not in too large quantity, it will
be gradually removed by the absorbents. In the contrary
case, it will form a swelling beneath the external cer-
trix, and present itself externally (see Dicours des Principales
Maladies observées à l'Hôtel Dieu de Lyon, &c. par Mr.
Petit, p. 299.) or else a counter opening must be practised
at the inferior part of the chest. See EMPIREMA.

We are to act quite differently in the treatment of a pe-
netrating wound of the belly, with protrusion and injury of
the intestine; for in this case, the chief indication, that on
which the patient's safety mainly depends, consists in keep-
ing the external wound open, in order that the feces may
find a ready outlet. The wounded bowel soon contracts
adhesions.
adhesions to the inner lips of the wound of the belly, and then we have nothing to fear from an extravasation of the intestinal matter in the cavity of the peritoneum. After- wards, in proportion as the feces resume their natural course, the external wound is to be allowed to diminish, and entirely heal up. See Scarp's Suller's Memorie Anatomico-Chirurgiche, &c. mem. 4.

In every instance in which the abdomen has received a penetrating wound, attended with injury and protrusion of a portion of the intestinal canal, the displace part is to be reduced, whether it be fitched or not. This should be accomplished as speedily as possible, before the bowel has suffered much from exposure, contusion, &c. and also before any adhesions have formed at the inner orifice of the external wound; adhesions which would render the reduction of the protruded part impracticable. Of course, if the wound should be too small to admit of the reduction being effected without handling and bruising the bowel immoderately, it ought to be carefully enlarged with a curved bistoury, guided on a director. Indeed, according to Scarp's principles, one would suppose that in every case of this kind the wound, if not free, should be dilated, as by this means the issue externally of whatever escapes from the breach in the intestine after its reduction would be facilitated. The rest of the treatment consists in the rigorous adoption of antiphlogistic measures, more especially a low diet, and copious and repeated enemata, with a view of counteracting the danger of peritoneal inflammation. With respect to the dressings, they cannot be too simple, and they ought always to be light and superficial. A pledge of any common unirritating ointment is all that is requisite, and it must be renewed as frequently as the quantity of the discharge, &c. from the wound may render necessary.

3. Penetrating Wounds of the Belly, attended with Injury of the Bowels, but with no Perforation.—A wound of the intestines is indicated by the discharge of blood with the fluits, and sometimes by the escape of fetid air, or of intestinal matter from the external wound. Such an injury, however, when the wounded bowels lie concealed in the belly, does not always admit of being known with certainty immediately after occurrence. In the majority of examples, there is at first no escape either of air, or of the contents of the bowels, from the external wound; the quantity of blood voided per anum may be inconceivable, and of course none at all will generally be discharged for some time after the accident. Wounds of the small intestines, especially of the duodenum and jejunum, are indeed usually followed by great anxiety, palene's of the countenance, syncope, cold per- spirations, a small intermitting tremulous pulse; but then these symptoms are only equivocal, and furnish no positive information, because several of them may happen in nervous subjeets, from a mere superficial unimportant cut or stab. Our inability, however, to say assuredly, in every case, whether the bowels are injured or not, is a thing of no practical importance; because when the nature of the accident is not clearly manifest by some peculiarity or severity of the symptoms, the case should invariably be treated on common, simple, antiphlogistic principles; and also, when circumstances leave not the smallest doubt of the intestines being hurt, the same treatment is the only rational one which can be pursued. Wounds of the small intestines are reckoned much more dangerous than those of the large; and the nearer the injury is to the pylorus, the greater, generally speaking, is the degree of danger. Such cases are also much more frequently, than injuries of the large intestines, the cause of extravasation. In the latter examples, the symptoms are commonly milder, and either the paffage of the intestinal contents outward through the wound more easy and certain, on account of the bowels being naturally less moveable than the other intestines; or their paffage in their natural course more ready, by reason of the greater capacity of that part of the intestinal tube.

A wounded intestine is said to present some particular appearances, to which the generality of writers have paid no attention. "If a gut be punctured, the elacticity of the peritoneum, and the contraction of the muscular fibres, open the wound; and the villous or mucous coat forms a fort of herinal protrusion, and obliterates the aperture. If an incised wound be made, the edges are drawn afunder and reverted, so that the mucous coat is elevated in the form of a flity lip. If the section be transverse, the lip is broad and bulbous, and acquires tympanification and redness from the contraction of the circular fibres behind it, which produces, relatively to the everted portion, the appearance of a cervix. If the incision is according to the length of the cylinder, the lip is narrow, and the contraction of the adjacent longitudinal, reftifying that of the circular fibres, gives the orifice an oval form. This eversion and contraction are produced by that series of motions, which constitutes the peristaltic action of the intestines." Travers on Injuries of the Intestines, p. 85.

According to this gentleman, some of these appearances were described by Haller, in Element. Physiol. lib. 24. feet. 2. and Opera Minora, tom. i. feet. 15.

Having witnessed the facility with which considerable injurys of the intestinal tube were repaired, Mr. Travers was desirous of ascertaining more fully the powers of nature in the process of spontaneou's repairation, and of determining under how great a degree of injury it would commence, as well as the mode of its accomplishment. For these purposes, he divided the small intestine of several dogs as far as the meenteery. All these animals died, in consequence of the intestinal matter being extravasated, if they had been lately fed, or if they had been falling in consequence of inflammation, attended with a separation of the ends of the divided bowel, eversion of the mucous coat, and obliteration of the cavity, partly by this eversion, and partly by a plug of coagulated chyly.

In one particular instance in which Mr. Travers made a division of the bowel half through its diameter, a fort of pouche was formed round the injured intestine. "A pouch, resembling somewhat the diverticulum in these animals, was formed opposite to the external wound, on the side of the paries, by the liring peritoneum; on the other side, by the meenteery of the injured intestine, that intestine itself, and an adjacent fold, which had contracted with it a close adhesion. The pouch, thus formed and inflated, included the opposed sections of the gut, and had received its content, &c. The tube at the orifices was narrowed by the half eversion, but offered no impediment to the passage of fluids." (P. 96.) Whether, under these circumstances, the functions of the alimentary canal could have been continued, Mr. Travers professes himself incapable of deciding. Among the inferences which this gentleman has drawn from the experiments detailed in his publication, the tendency of the two portions of a divided bowel to recede from each other, instead of coalecing to repair the injury, merits no notice, inasmuch as it tends to shew that the only means of spontaneous reparation consist in the formation of an adventitious canal, by the encircling bowels and their appendages. The everted mucous coat, which is the part opposed to the surrounding peritoneum, is also indispended to the adhesive inflammation.
the obstacles to reparation are not absolutely insurmountable. Here retraction is prevented, and the processes of eversion and contraction modified by the limited extent of the injury. If, therefore, the adhesive inflammation unite the contiguous surfaces, effusion will be prevented, and the animal clefts immediate destruction. But union can only take place through the medium of the surrounding parts.

According to Mr. Travers, it is the retraction immediately following the wound that is a chief obstacle to the reparation of the injury; for if the division be performed in such a way as to prevent retraction, the canal will be restored in so short a time, as but slightly to interrupt the digestive function. In confirmation of this statement, a ligature was tightly applied round the duodenum of a dog, which became ill, but entirely recovered, and was killed. "A ligature, fastened across the intestine, divides the interior coats of the gut, in this effect resembling the operation of a ligature upon an artery. The peritoneal tube alone maintains its integrity. The inflammation, which the ligature induces on either side of it, is terminated by the deposition of a coat of lymph, which is exterior to the ligature, and quickly becomes organized. When the ligature, thus enclosed, is liberated by the ulcerative process, it falls of necessity into the canal, and pails off with its contents." P. 103, 104.

It appears also from Mr. Travers's experiments and observations, that longitudinal wounds of the bowels are more easily repaired than such as are transverse. In a dog, a longitudinal wound, of the extent of an inch and a half, was repaired by the adhesive inflammation. Here the process of eversion is very limited; the aperture bears a smaller proportion to the cylinder of the bowel; and the entire longitudinal fibres resist the action of the circular, which are divided, and can now only slightly lessen the area of the canal. P. 108.

When the wounded bowel lies within the cavity of the abdomen, no surgeon of the present day would have the rashness to think of attempting to expose the injured intestine, for the purpose of sewing up the breach of continuity in it. In fact, the surgeon seldom knows at first what has happened; and when the nature of the case is afterwards manifest, by the discharge of blood per anum, an extravasation of intestinal matter, &c. it would be impossible to get at the injured part of the bowel, not only because its exact situation is unknown, but more particularly on account of the adhesions, which are always formed with surprising rapidity. But even if the surgeon knew to a certainty, in the first instance, that one of the bowels was wounded, and the precise situation of the injury, no future could be applied, without considerably enlarging the external wound, drawing the wounded intestine out of the cavity of the abdomen, and handling and disturbing all the adjacent viscera. Nothing would be more likely than such proceedings to render the accident, which might originally be curable, unavoidably fatal. We must agree upon this point with Mr. John Bell, who says, "When there is a wounded intestine, which we are warned of only by the passing out of the feces, we must not pretend to search for it, nor put in our finger, nor expect to find it otherwise the wound; but we must trust that the universal peristalsis, which prevents great effusion of blood, and collects the blood into one place, that very peristalsis, which always causes the wounded bowel and no other to protrude, will make the two wounds, the outward wound and the inward wound of the intestine, oppose each other point to point; and if all be kept there quiet, though but for one day, it is the tendency to inflame, that the adhesion will be broken, which is to save the patient's life." Dicources on Wounds, p. 361. edit. 3.

When the extravasation and other symptoms, a few days after the accident, evince the nature of the case, a future can be of no use whatever, as the adhesive inflammation has already fixed the part in its situation, and the space, in which the extravasation lies, is completely separated from the general cavity of the abdomen by the surrounding adhesions.

When the bowel is not protruded, and the opening in it is situated closely behind the wound in the peritoneum, a future is not requisite; for the contents of the gut, not passing onward, will be discharged from the outer wound, and not be diffused among the viscera, if care be taken to keep the external wound open. There is no danger of the wounded bowel changing its situation, and becoming distant from the wound in the peritoneum; for the situation which it now occupies is its natural one. Nothing but violent motion, or exertions, could cause so unfavourable an occurrence, and these should always be avoided. The adhesions, which take place in the course of a day or two, at length render it impossible for the bowel to swell its situation. See dictated. of Pract. Surgery, edit. 3. art. Wounds.

In a penetrating wound of the abdomen, as a late author remarks, whether by gun-shot, or a cutting instrument, if no protrusion of intestine takes place, (and this, it must be observed, in musket or pistol wounds, rarely occurs,) the laceration, with its powerful concomitants, abstinence and rest, particularly in the supine posture, are our chief dependence. Great pain and tension, which usually accompany these wounds, must be relieved by leeches, if they can be procured, by the topical application of fomentations, and the warm bath; and if any internal medicine is given as a purgative, it must, for obvious reasons, be of the mildest nature. The removal of the ingesta, as a source of irritation, is best effected by frequently repeated olistegious gisters; indeed, on the first infliction of a wound of the abdomen, the contents of the intestinal canal and stomach are generally evacuated spontaneously, the fluids being sometimes tinged with blood. Their accumulation must be guarded against by a rigorous diet; for to the general state of fulness of the viscidus induced by food, is added its local and mechanical stimulus in the undigested form. By this treatment, penetrating wounds, in which several pieces of intestines have been necessarily implicated, have been happily cured. Authors abound with instances of this kind, and Mr. Hennen has seen several: among others, he was witness to the recovery of a soldier, who had been shot through the abdomen with a ramrod, at the siege of Badajos in 1812, which passed in anteriorly, and actually stuck in the vertebra, from which it was not disengaged without the application of some force. Garengott and Lamotte also record cures, after the passage of swords completely through the body. See Hennen's Obs. on Military Surgery, p. 436, 437.

In all penetrating wounds of the belly, the dressings cannot be too simple and light.

In some inflections, the ball, or part of the weapon which has inflicted the wound, remains within the abdominal cavity, and is afterwards evacuated by the natural pusses. Balls, says Mr. Hennen, frequently pass clean through the abdomen, evidently wounding the intestines, but without occasioning any protrusion of them at either of the orifices. These cases, like all others of those parts, are extremely dangerous, but are not necessarily mortal. They require the most guarded attention, and the utmost watchfulness of the approach of inflammation, which often comes on most indifferently. The mildest possible application should be employed to the wounds, and no pulling with tents.
or introduction of medicated dressings thought of. (P. 440.)
At first a common linseed poultice, and afterwards simple
pledgets, are as eligible dressings as any which can be men-
tioned.

Extrafation in the Abdomen.—Wounds of the abdomen
may be complicated with extravasations of blood, chyle, ex-
crenient, bile, or urine. None of these complications, however,
are half so frequent as an unremitting and inexpe-
rienced practitioners might apprehend. The employment of
the phrase cavity of the abdomen has paved the way to much
erroneous supposition upon this subject, and has induced
many absurd notions, which even the ablest observations
long ago published by Petit (le fils) have fearlessly yet
diffused.

As a modern writer has observed, “there is not truly any
cavity in the human body, but all the hollow bowels are filled
with their contents, all the cavities filled with their hollow
bowels, and the whole is equally and fairly press'd. Thus,
in the abdomen all the viscera are moved by the diaphragm
and the abdominal muscles, upwards and downwards, with
an equable continual preffure, which has no interval; and one
would be apt to add, the intestines have no repose, being
kept thus in continual motion; but though the action of the
diaphragm, and the re-action of the abdominal muscles, are
alternate, the preffure is continual; the motion which it
produces (they produce) is like that which the bowels have
when we move forwards in walking, having a motion with
respect to space, but none with regard to each other, or to
the part of the belly which covers them; the whole mass of
the bowels is alternately press'd, to use a coarse illuftration,
as if betwixt two broad boards, which keep each turn or in-
tefline in its right place, while the whole mass is regularly
moved. When the bowels are forced down by the dia-
aphragm, the abdominal muscles recede: when the bowels
are pushed back again, it is the re-action of the abdominal
muscles that forces them back and follows them; there is
never an instant of interruption of this preffure, never a
moment in which the bowels do not press against the peri-
toneum; nor is there the smallest reason to doubt that the
same points in each are continually opposed. We feel that
the intestines do not move, or at least do not move to move
in performing their functions; for in hernia, where large
turns of intestines are cut off by gangrene, the remaining
part of the same intestines is closely fix'd to the groin, and
yet the bowels are easy, and their functions regular. We
find the bowels regular when they lie out of the belly in
hernia, as when a certain turn of intestine lies in the feromum,
or thigh, or in a hernia of the navel; and where yet they
are so absolutely fixed, that the piece of intestine is marked
by the straightness of the rings. We find a person, after a
wound of the intestine, having free fiows for many days;
and what is it that prevents the feces from escaping, but
merely this regular and universal preffure? We find a per-
son on the fourth or fifth day with feces coming from the
wound! a proof, surely, that the wound of the intestine
is still opposite, or nearly opposite, to the external wound.
We find the same patient recovering without one bad sign! I
What better proof than this could we desire, that none of
the feces have exceded into the abdomen?

If in a wound of the stomack the food could get
casilly out by that wound, the stomack would unload itself
that way, there would be no vomiting, the patient might
die; but fo regular and continual is this preffure, that the
inflant a man is wounded in the stomack he vomits, he con-
tinues vomiting for many days, while not one particle escapes
into the cavity of the abdomen. The outward wound is
commonly opposite to that of the stomack, and by that
passage some part of the food comes out; but when any ac-
cident removes the inward wound of the stomack from
the outward wound, the abdominal muscles press upon the
stomack, and follow it so closely, that if there be not a mere
laceration extremely wide, this preffure closes the hole, keeps
the food in, enables the patient to vomit, and not a particle,
even of jelli's or soups, is ever lofd, or goes out into the
cavity of the belly.

"How (proceeds Mr. J. Bell), without this universal and
continual preffure, could the viscera be supported? Could
its ligaments, as we call them, support the weight of the
liver? Or, what could support the weight of the stomack
when fill'd? Could the melentry or omentum support the
intestines; or could its own ligaments, as we still name them,
support the womb? How, without this uniform preffure,
could these viscera fail to give way and burst? How could
the circulation of the abdomen go on? How could the
liver and spleen, so turgid as they are with blood, fail to
burst? Or, what possibly could support the loose veins
and arteries of the abdomen, since many of them, e. g. the
spleenic vein, is (are) two feet in length, is (are) of the
diameter of the thumb, and has (have) no other than the
common pellucid and delicate coats of the veins? How
could the viscera of the abdomen bear shocks and falls, if
not supported by the universal preffure of surrounding
parts? In short, the accident of hernia being forced out
by any blow upon the belly, or by any sudden strain, explains
to us how perfectly full the abdomen is, and how ill it is to
bear any preffure, even from its own muscles, without
some point yielding, and some one of its bowels being thrown
out. And the fickens and faintneds, which immediately
follow the drawing off of the waters of a dropsey, explain
to us what are the consequences of such preffure being even
for a moment relaxed. But perhaps one of the strongest
proofs is this, that the principle must be acknowledged, in
order to explain what happens daily in wounds; for though
in theory we should be inclined to make this distinction,
that the hernia, or abscefs of the intestines, will adhere
and be safe, but that wounded intestines, not having time to
adhere, will become flaccid, as we see them do in diffecions,
and so, falling away from the external wound, will pour
their feces into the abdomen, and prove fatal; though we
should settle this as a fair and good distinction in theory,
we find that it will never answer in practice. Soldiers re-
cover daily from the most desperate wounds; and the most
likely reasons that we can assign for it are, the fulness of
the abdomen, the universal, equable, and gentle preffure,
and the active disposition of the peritoneum ready to inflame
with the slightest touch. The wounded intestine is, by
the universal preffure, kept close to the external wound, and
the peritoneum and the intestine are equally inclined to adhere.
In a few hours that adhesion is begun which is to save the
patient's life, and the lips of the wounded intestine are
clued to the lips of the external wound. Thus is the side
of the intestine united to the inner surface of the abdomen;
and though the gut calls out its feces while the wound is
open, though it often calls them out more freely while the
first inflammation lasts, yet the feces refuse their regular
course whenever the wound is diffeped to close," John
Bell's Discourses on Wounds, p. 323—327, edit. 3.

The foregoing extract, though drawn up in the most
careless style, contains such observations as are well calcu-
lated to make the reader understand that the abdomen is in
reality not a cavity, but a compact mass of containing and
contained parts; that the close manner in which the various
surfaces are constantly in contact must powerfully oppose ex-
travasations; and that in fact it often entirely prevents
WOUNDS.

them. The passage cited impresses us with the utility of that quick propensity to the adhesive inflammation which prevails throughout every peritoneal surface, and which not only often has the effect of permanently hindering effusion of the contents of the viscéra, by agglutinating the parts together, but which, even when an extravasation has happened, beneficially confines the effused fluid in one mass, and surrounds it with such adhesions of the parts to each other as are rapid in their formation, and effectual for the purposes of limiting the extent of the effusion, and preventing the irritation of the extraneous matter from affecting the rest of the abdomen.

It is to M. Petit that we are indebted for the introduction of more correct modes of thinking upon the foregoing subject. See Mem. de l'Acad. de Chirurgie.

But notwithstanding the influence of the reciprocal pressure of the containing and contained parts against each other, and the useful effect of the quickly arising adhesive inflammation in all penetrating wounds of the belly, complicated with the injuries of the viscéra, we are not to suppose that extravasation never happens, but only that it is much less frequent than has been commonly supposed. Mr. Travers, with much laudable industry, has endeavored to trace more minutely than any preceding writer the particular circumstances under which effusions in the abdomen are likely or unlikely to happen. "It being admitted (says he) that there are cases in which effusion does take place, it is easy to conceive circumstances which must considerably influence this event. If, for example, the stomach and bowels be in a state of emptiness, the nausea which follows the injury will maintain that state. If the extent of the wound be considerable, the matter will more readily pass through the wound than along the canal. A wound of the same dimensions in the small and the large intestines will more readily evacuate the former than the latter, because it bears a larger proportion to the calibre. Incised and punctured wounds admit of the adhesion of the cut edges, or the eversion of the internal coat of the gut, so as to be in many instances actually obliterated; whereas lacerated or ulcerated openings do not admit of these falutary processes. Again, in a transverse section of the bowel, the contraction of the circular fibre closes the wound, whereas in a longitudinal section, the contraction of this fibre enlarges it. Such (says Mr. Travers) are the circumstances which, combined in a greater or less degree, increase or diminish the tendency to effusion." On Injuries of Intestines, &c. p. 13, 14.

After the details of some experiments and cases, the preceding author makes among other conclusions the following:

1. That effusion is not an ordinary consequence of penetrating wounds.

2. That if the gut be full, and the wound extensive, the surrounding pressure is overcome by the natural action of the bowel tending to the expulsion of its contents.

3. That if food has not recently been taken, and the wound amounts to a division of the gut, or nearly so, the eversion and contraction of the orifice of the tube prevent effusion.

4. That if the canal be empty at the time of the wound, no subfrequent state of the bowel will cause effusion, because the supervening inflammation agglutinates the surrounding surfaces, and forms a circumscribed face; nor can effusion take place from a bowel at the moment full, provided it retains a certain portion of its cylinder entire, the wound not amounting nearly to a semi-division of the tube, for then the eversion and contraction are too partial to prevent an extravasation.

5. That when, however, air has escaped from the bowel, or blood has been extravasated in quantity within the abdomen at the time of the injury, the resistance opposed to effusion will be less effectual, although the parietal pressure is the same, as such fluids will yield more readily than the solids naturally in contact. P. 25, 26, 100.

6. That though extravasation is not common in penetrating wounds, it follows more generally in cases where the bowel is ruptured by blows, or falls upon the belly, while the integuments continue unwounded. P. 36.

7. That when the bowels are perforated by ulceration, there is more tendency to effusion than in cases of wounds. P. 38, &c.

Mr. Travers explains the reason of the greater tendency to effusion, in cases of intusseption burst by violence, and in those of ulceration, "by the difference in the nature of the injury which the bowel sustains when perforated by a sword or bullet, as in the one case, or burst or ulcerated in the other. A rupture by concussion could only take place under a diffused state of the bowel, a condition most favourable to effusion, and from the texture of the part, a rupture so produced would seldom be of limited extent. The process of ulceration, by which an aperture is formed, commences in the internal coat of the bowel, which has always incurred a more extensive lesion than the peritoneal covering. The puncture or cut is merely a solution of continuity in a point or line; the ulcerated wound is an actual loss of substance. The consequence of this difference is, that while the former, if small, is glued up by the effusion from the cut vessels, or, if large, is nearly obliterated by the full eversion of the villous coat, the latter is a permanent orifice." P. 46.

Blood is more frequently extravasated in the abdomen than any other fluid. Extravasations of this kind, however, do not invariably happen, whenever vessels of not a very considerable size are wounded. The compact state of the abdominal viscéra, in regard to each other, and their action on each other, oppose this effect. The action alluded to, which depends on the abdominal muscles and diaphragm, is rendered very manifest by what happens in consequence of operations for hernia. The weakened and atrophied state of the peritoneal covering, the blood vessels being in a state of stasis, is contributed to the disorganization of the whole gut, which continues to be the source of the disease. The blood existing promiscuously extravasated over every part of the abdomen. But when such bodies are examined with care, it will be found that the
the blood does not infinate itself among the viscera till the moment when the abdomen is opened, and the mafs previously lies in a kind of pouch. This pouch is frequently circumcised, and bounded by thick membranes, especially when the extravasation has been of some standing. Sabatier, Medecine Opératoire, tom. i. p. 28—30.

It is of the highest consequence to a practical surgeon to remember well that all the parts contained in the abdomen are closely in contact with each other, and with the inner surface of the peritoneum. This is one grand reason why extravasations are seldom so extensively diffused as one might imagine, but commonly lie in one mafs, as Petit, Sabatier, and all the best moderns, have noticed. The preflure of the elastic bowels, of the diaphragm, and abdominal muscles, not only frequently presents an obstacle to the diffusion of extravasated matter, but often serves to propel it towards the mouth of the wound. The records of surgery make mention of numerous instances in which persons have been stabbed through the body without any fatal consequences, and sometimes without the symptoms being even severe. In Mr. Travers’s publication many cafes exemplifying this observation are quoted from a variety of sources. Fab. Hildan. Obs. Chirurg. cent. v. obs. 74. Œuvres de Paré, liv. x. chap. 35. Wileman’s Surgery, p. 371. La Motte’s Traité Complet de Chirurgie, &c. &c. In such cases, the bowels have been supposed to have eluded the point of the weapon, and this may, perhaps, in a few instances, have been actually the fact; but in almost all such examples there can be no doubt that the bowels have been punctured, and an extravasation of intestinal matter has been prevented by the opposite preflure of the adjacent viscera. Such resistance and preflure may also have occasionally obliged intestinal matter, or blood actually extravasated, to pass through the wound of the bowel into its cavity, and thus be speedily removed. Certain it is, such copious evacuations of blood per anum have followed in these cases as could hardly proceed from the arteries of the intestines. This way of getting rid of an extravasation must be rare, however, compared with that by absorption.

The pouch or cyst including extravasated blood or matter, as mentioned by Sabatier, is formed by the same process which circumcibes the matter of abscesses. (See Suppuration.) It is in short the adhesive inflammation. All these surfaces in contact with each other, and surrounding the extravasation and track of the wound, generally soon become so intimately connected together by the adhesive inflammation, that the place in which the extravasation is lodged is a cavity entirely delitute of all communication with the cavity of the peritoneum. The track of the wound leads to the seat of the effused fluid, but has no distinct opening into the general cavity of the abdomen. The rapidity with which the above adhesive form is often very great, almost incredible.

Urine and bile are more frequently dispersed to a great extent among the abdominal viscera than blood. The latter fluid, indeed, must often coagulate; a circumstance that must both tend to stop further hemorrhage, and confine the extravasation in one mafs.

Symptoms and Treatment of Extravasations in the Abdomen.

—1. Blood.—Wounds of the spleen, and of such veins and arteries as are above a certain size, almost always prove fatal from internal hemorrhage. The blood generally makes its way downwards, and accumulates at the inferior part of the abdomen, unless the existence of adhesions happen to oppose the descent of the fluid to the most depending situation. The belly swells, and the fluctuation of a fluid is perceptible through the anterior part of the abdominal parietes. The patient grows pale, loses his strength, is affected with syncope, and his pulse becomes weaker and weaker. In short, the symptoms usually attendant on hemorrhage are observable. The viscera and vesels in the abdomen being continually compressed on all sides by the surrounding parts, the blood cannot be effused without overcoming a certain degree of resistence; and unless a vesel of the first magnitude, like the aorta, the vena cava, or one of their principal branches, has been wounded, the blood escapes from the vesel slowly, and several days elapse before any considerable quantity has accumulated in the lesser cavity of the pelvis.

In these cases of extravasated blood, the symptoms, which perhaps had disappeared under the employment of bleeding and anodyne medicines, now come on again. A soft fluctuating tumour may be felt at the lower part of the abdomen, sometimes on the right side, sometimes on the left, occasionally on both sides. The preflure made by the effused blood on the urinary bladder excites dilating inclinations to make water; while the preflure which the sigmoid flexure of the colon suffers is the cause of obstinate constipation. In the mean time, the quantity of extravasated blood increasing, irritation and inflammation of the peritoneum are induced. The pulse grows weaker, debility ensues, the countenance is moistened with cold perpirations; and, unless infligted by all the antecedent circumstances, the surgeon practices an incision for the discharge of the fluid, the patient falls a victim to the accident.

In the year 1733, Vacher, principal surgeon of the military hospital at Belaçon, successfully adopted this mode of treatment. Petit (the son) afterwards tried the same plan, though it did not answer, (as is alleged,) in consequence of the inflammation having advanced too far before the operation was performed. Long before the time of Vacher and Petit, a successful instance of similar practice had been recorded by Cabrolc.

Indeed, when the symptoms leave no doubt of there being a large quantity of blood extravasated in the abdomen; when the patient’s complaints are of a very serious nature, and are evidently owing to the irritation and preflure of the blood on the surrounding viscera; and when a local swelling denotes the seat of the extravasation, there cannot be two opinions about the propriety of making an incision for its evacuation.

Surgeons, however, should recollect, that a small extravasation of blood may exift without producing any considerable irritation, provided no opening be made into the cyst with which it becomes surrouniled. On the contrary, when such cyst is opened, the air then having free access to the blood contained there, that part of the fluid which cannot be discharged is apt to putrefy, and become so irritating, as to excite inflammation of the surrounding parts.—Even though there may be an evident extravasation of blood, the bad symptoms are also sometimes entirely owing to the injury done to the parts within the abdomen, and neither to the preflure nor the irritation of the effused blood.

But sometimes, as we have already noticed, the accumulated blood at first neither irritates the adjacent parts by its quantity nor quality. An inflammation, however, of the parts surrounding the extravasation at length takes place. The tenion, irritation, and pain, which in the first instance arose from the wound itself, and subsided, seem now to be renewed. When the extravasation is at the lower and anterior part of the abdomen, the patient experiences pain about the hypogastric region. He is also constipated, and as he
WOUNDS.

Suffers great irritation of the bladder, he feels frequent propensities to make water, but cannot relieve himself. At last, a tumour makes its appearance, attended with a fluctuation more or less distinct.

In this infall, it seems proper to give vent to the accumulated blood. If this fluid should be found coagulated, injections of warm water would facilitate its discharge. Sabatier, Médecine Opératoire, tom. i. p. 34.

2. Chyle and Feces.—These are not so easily extravasated in the abdomen as blood, because they do not require so much resistance on the outside of the stomach and intestines, to make them continue their natural route through the alimentary canal, as blood requires to keep it in the vessels. Extravasations of this kind, however, sometimes happen when the wound is large and the bowel dilated at the moment of the injury, or when, as Mr. Travers has likewise explained, air is extravasated, or blood effused in the abdomen; these fluids being incapable of making effectual resistance to the escape of the intestinal matter. (See an Inquiry into the Proces of Nature in Repairing Injuries of the Intestines, &c. p. 26.) Nothing is a better proof of the difficulty with which chyle and feces are extravasated than the operation of an emetic, when the abdomen is wounded and full of aliment. In this instance, if the resistance to the extravasation of the contents of the stomach were not considerable, they would be effused in the abdomen, instead of being vomited up. A peculiarity in wounds of the stomach and intestines is, that the opening which allows their contents to escape may also allow them to return into the wounded orifices.

Extravasation of intestinal matter in the abdomen is attended with a feverish train of febrile symptoms; dryness of the mouth, tongue, and fauces; considerable pain and swelling of the belly; convulsive disorders; hicouche and vomiting, with which the patients are generally attacked on the day after that on which the wound was received. Sabatier de la Médecine Opératoire, tom. i. p. 34.

In these cases, general means are the only ones which can be employed; venesection, fomentations, low diet, perfect rest, anodynes, &c. All solid food must be most strictly prohibited. The close state of the vasa may also be increased by applying a bandage round the body.

If the symptoms are not speedily allayed, the abdominal vasa become affected with general inflammation and gangrene, and the patients die in the course of a few days.

3. Bile.—Bile, on account of its great fluidity, is more easily extravasated extensively in the abdomen than either blood or the contents of the stomach and intestines. Besides, the gall-bladder has the power of contracting itself so completely as to expel the whole of its contents. Notwithstanding these circumstances, however, extravasations of this kind are exceedingly uncommon, doublets on account of the small size of the gall-bladder, and its deep-guarded situation, between the concave surface of the liver and upper part of the transverse arch of the colon.

Sabatier informs us, that he has only been able to find one example on record. This case, after having been communicated to the Royal Society of London by Dr. Steward (Nº 414, p. 341. Abridgm. tom. vii. p. 571, 572.), was inserted as an extract in the third volume of the Edinburgh Essays, and also in the third volume of Van Swieten's Commentaries on the Aphorisms of Boerhaave. (Tramf. p. 65. edit. 1754.) An officer received a wound, penetrating the cavity of the abdomen, and entering the fundus of the gall-bladder, without doing any material injury to the adjacent parts. The abdomen immediately distended, as if the patient had been afflicted with an afflication, or tympanitis; nor did the swelling either increase or diminish till the patient's death, which happened a week after the infliction of the wound.

There was no rumbling noise in the abdomen, though it was exceedingly tense. There were no furs, and very little urine was discharged, notwithstanding purgatives and glysters, and a good deal of liquid nourishment, were given. The patient never had one exhalant of found deep, but was always resolved, though anodynes were exhibited. There was no appearance of fever, and the pulse was always natural till the last day of the patient's life, when it became intermittent. The intestines were found, after death, very much dilated, the gall-bladder quite empty, and a large quantity of bile extravasated in the abdomen.

Sabatier met with an opportunity of observing the symptoms of an extravasation of bile, in consequence of a wound of the gall-bladder. The patient's abdomen swelled very quickly; his respiration became difficult, and he soon afterwards complained of tension, and pain in the right hypochondium. His pulse was small, frequent, and contracted; his extremities were cold, and his countenance very pale. The bleedings which were praefcribed the first day gave him a little relief; but the tension of the abdomen, and the difficulty of breathing, still continued. A third bleeding threw the patient into the lowest state of weakness, and he vomited up a greenish matter. On the third day, the lower part of the belly was observed to be more prominent, and there was no doubt of an extravasation. M. Sabatier introduced a trocar, and gave vent to a green blackish fluid, which had no smell, and was pure bile, that had escaped from the wound of the gall-bladder. After the operation, the patient grew weaker and weaker, and died in a few hours. On opening the body, a large quantity of yellow bile was found between the peritoneum and intestines; but it had not infiltrated itself among the convolutions of the vasa. A thick glutinous connected the bowels together, and they were prodigiously dilated. The gall-bladder was shrunken, and almost empty. Towards its fundus, there was a wound about a line and a half long, corresponding to a similar wound in the peritoneum. The wound which had occurred at the middle and lower part of the right hypochondrium, between the third and fourth false ribs, had glided from behind forward, and from above downward, between the cartilages of the ribs, until it reached the fundus of the gall-bladder.

Sabatier takes notice, that the symptoms of the two cases which have just now been related were very similar. Both the patients were affected with an exceedingly tense swelling of the belly, unattended with pain or borborygium, and they were both obstinately constricted. Their pulse was extremely weak the latter days of their indisposition, and they were afflicted with hicouche, nausea, and vomiting.

M. Sabatier seems to think one thing certain, viz. that wounds of the gall-bladder, attended with effusion of bile, are absolutely mortal, and that no operation can be of any avail. Médecine Opératoire, tom. i. p. 34—37.

We are, however, to infer the contrary from the extraordinary case lately published by Mr. Fryer of Stamford. A boy, about thirteen years old, received a violent blow from one of the shafts of a cart, on the region of the liver. The injury was succeeded by pain, frequent vomiting of bilious matter, great sinking, coldness of the extremities, and a weak, small, fluttering pulse. The belly was fomented, and purging glysters thrown up. On the third day, symptoms of inflammation began, attended with considerable pain about the liver, great tension and forensis of
the abdomen, and frequent vomiting. The pulse was quick, small, and weak, the skin hot and dry, the tongue much furred, the urine high coloured; and there was some difficulty of breathing, and great thirst. Eight ounces of blood were taken away, the fomentations continued, and a few grains of calomel were directed to be given every four hours, until the bowels were properly opened. Afterwards the effuving mixture, with ten drops of laudanum, was exhibited every four hours.

On the following day, the patient had some motions, and was much better; but as his fickness continued, he was ordered a grain of opium every four hours. About a week afterwards, he complained of a great increase of pain, which was somewhat relieved by a blister. He was now completely jaundiced, and his stools were white, but the tension, pain, and sicknes, were abated.

Two days afterwards, a fluctuation was perceived in the abdomen, which in another week became considerably diffused with fluid. The patient now did not complain of much pain, but appeared to be sinking fast; a puncture was made in the swelling, and thirteen pints of what appeared to be pure bile were evacuated. The bowels then soon became regular, and the appetite good. In twelve days, the operation was repeated, and fifteen pints of the fame bilious fluid were drawn off. Nine days afterwards, another puncture was made, and thirteen pints more let out; and five were discharged in another fortnight. From this period the boy went on well, and perfectly recovered under the use of light tonic medicines. See Medico-Chirurgical Transactions, vol. iv. p. 330.

A previous accidental adhesion of the gall-bladder to the peritoneum might also certainly prevent the extravasation of bile, and its dangerous effects. Callifen, Synt. Chir. Ho-dierau, tom. i. p. 718.

Mr. Hennen has never known a patient recover after a wound of the gall-bladder; and indeed, says he, it is difficult to imagine a case where the injury could happen without an effusion of bile into the abdominal cavity, except a previous adhesion had taken place to the parietes. A case, however, is mentioned in the "Opuscules de Chir." of M. Paroiffe, where a leaden ball had lodged in the gall-bladder two years.

4. Urine.—Urine being of a very fluid nature may, like the bile, be easily extravasated in the abdomen, when the bladder is wounded at any part which is connected with the peritoneum. If the urine in this kind of case be not drawn off with a catheter, so as to prevent it from issuing by the wound of the bladder, the patient soon perishes. There are many instances recorded of the bladder being injured even by gun-shot wounds which were not mortal. (See Larrey's Mém. de Chr. Mil. especially tom. iv.) Such wounds, however, might only have injured the sicles or lower part of the bladder. But in operating for the stone above the pubes, the bladder has undoubtedly been occasionally cut at the part of the fundus which is covered with the peritoneum. However, as the accident was known in the first instance, the right treatment was adopted, and such patients have recovered. Sabatier, Médecine Opératoire, tom. i. p. 37.

Wounds of the bladder are particularly characterized by a discharge of bloody urine and difficulty of making water. They must always be regarded as dangerous cases, both on account of the risk of the effusion of fro irritating a fluid in the abdomen, and of the chance of extravasation in the cellular membrane. Under proper treatment, however, they often admit of cure. The effused fluid should, if possible, be discharged by a depending poulter, or suitable punctures or incisions, and its recurrence prevented by the introduction of a catheter, which is to be left in the urethra. The patient must also be allowed little drink. As for the tension and pain of the belly, the perpetual attendants of a wounded bladder, they may be greatly relieved by the use of the warm bath. (Callifen, tom. i. p. 719.) Bleeding and other antiphlogistic means are not to be omitted. See Dict. of Pract. Surg. art. Wounds.

Extraneous bodies, particularly balls, as Mr. Hennen observes, are frequently carried into the bladder itself, either as it rises above the pubes or through the openings in the pelvis, or work their way into it, and either come off by the natural passage, or are removed by a surgical operation resembling lithotomy. Wounds of the bladder, he remarks, are dangerous in proportion as it is full of urine at the time of their receipt, or as the upper and anterior, or lower and posterior part of the viscus may be wounded. If the intestines are implicated in the wound, it is highly dangerous. Inflammation from wounds of these parts runs rapidly into gangrene, which is chiefly brought on by the effusion of urine in the cellular membrane. "If there is a free extensive passage, much of this danger will be obviated; and after the first effusion from the bladder has taken place, the judicious use of the elastic gum catheter affords us an admirable assistance against this accident. "Indeed," says Mr. Hennen, "without this useful instrument, our practice in wounds of this nature, and in those affecting the urethra, would be merely confined to looking on and moderating symptoms, instead of preventing them." (P. 460.) The rest of the treatment consists in letting out, without delay, the effused urine by proper incisions, and employing the antiphlogistic plan, in the full sense of the expression, together with mild superficial dressings or poultices, and the utmost attention to cleanliness.

A deep wound of the liver, Mr. Hennen considers as fatal as one of the heart itself. Slighter injuries of this organ, he sets down as sometimes recovering. He says, that the usual symptoms which characterize wounds of the liver are, yellowness of the skin and urine, derangement of the stomach and of the alimentary canal, and cutaneous affections, particularly great and distressing itching. The discharge from the wound is generally yellow and glutinous; but he has seen it of a serous nature, and sometimes very nearly allied to unmixed bile.

Wounds of the liver, says another writer, may cause a large effusion of blood from the outer wound, or in the abdomen, a cadaverous yellow countenance, pain in the shoulder, flow pulse, dulness of the eyes, great anxiety, cold sweats, and finally death, which happens the more quickly and certainly, the greater the wound is, and the nearer it is situated to the place where the large vessels enter this organ. But small wounds of the liver, particularly of its convex surface, when it is adherent to the peritoneum, admit of cure. Callifen, tom. i. p. 718.

The treatment is to be first conducted entirely on antiphlogistic principles, venefication, and mild aperient medicines in particular being employed. Afterwards small doses of the pil. hydrag. and tonic medicines will tend to re-establish the health.

A wound of the stomach may be known by the discharge of aliment from the external opening; by the vomiting of blood; the pain, the anxiety, and other symptoms of violent nervous irritation. Large wounds of this organ, especially those about the cardiac orifice, or great curvature, or such as extend through both sides of the viscus, are for the most part fatal in a few days; but when the wound is differently situated, and properly treated, it may often be cured. In certain instances, however, a fistula remains, through which
a part of the food sometimes escapes. Two cases of wounds of the stomach are recorded by Dr. Thomfon, in his Obf. on the Military Hospitals in Belgium. One was from a musket-ball; the other from a pike. They were treated on the mild, unirritating plan, adapted for wounds of the intestines, and both ended well. "The histories of the Bohemian, Prussian, and English 'cultrivores,' from some of whom the knives have been cut out, and from others discharged spontaneously, through the coats of the stomach and parietes of the abdomen, as well as many other instances on record, are (as Mr. Hennen observes) very encouraging in cases of injuries of this organ." M. Hevin, in the Mem. de l'Acad. de Chir., tom. i. p. 144, has collected a number of interesting instances of recovery, both from incised and gun-shot wounds. But (says Mr. Hennen) the industrious Plouquet, in the articles "Ventriculus" and "Pantopagi," has exceeded all others for the vast number of cases he has amassed. In our own Philosophical Trans., Lowthorpe’s Abridgment, vol. vi. p. 192, or in the modern one, by Drs. Hutton, Shaw, and Pearfon, vol. iv. p. 66, an instance is given, where the stomach of a horfe was wounded and fewed up, and a similar instance in the human species: both recovered. More recently futures have been applied to its wounds in Holland and France, as may be found in the "Annales de Litterature," &c. by Klyuyvens, vol. 2, and in the s Traumalologia" of Schlichting, &c. Notwithstanding these instances, however, we have no doubt of the rational of fuch practice, and all that can be faid about it, that the patients had to overcome both the injury and the bad treatment of it. Not unfrequently a wound of the fomach becomes fistulous. Richerand gives a very curious cafe of this kind, where the opening remained for nine years, Etmüller, in the 5th vol. of Haller’s "Disputations Chirurgica," gives an instance, where it continued open for ten years; and Wenker, in the fame volume, relates a cafe where a wound of the fomach continued open twenty-seven years. (See Hennen on Military Surgery, p. 481, &c.) Copious bleeding, abfolute, and reft, are the beft remedies in the early stage of all fuch cafes.

Wounds of the fpleen only prove fatal by the profuse hemorrage arising from them. Mr. Hennen, however, affures us, that he has seen fome flight wounds of this viscus termine favourably. It has fometimes been cut out of brutes, without any fatal or even any bad confequences; and there is a recent instance recorded, in which it protruded from an incised wound, the furgeon removed it, and the patient got well. (See Medico-Chirurg, Journal, vol. i. 1816.) It has also been tied and cut out in fome other infirmities with fuccefs. See cafes in Gooch’s Chr. Works, vol. i, p. 97; Leveillé’s Doctrine Chr. tom. i. p. 400; also fome references in Thomæ Bartholini Anatomie, p. 138. 8vo. Lugd. Bat. 1866, &c.

Wounds of the fpleen have fcarcely any symptom which is peculiar to them. According to Celfus, however, there is great pain in the fhouder, as in wounds of the liver. The folute structure of the fpleen, and the magnitude of its veffels, must always render its injuries highly dangerous.

Wounds of the pancreas, according to Callifen, are not characterized by any peculiar symptom, except the effufion of a fluid analogous to the faliva. The pancreas, like the duodenum, can hardly be wounded, without the weapon having at the fame time injured other viscera. (Syll. Chr. Hodiernæ, tom. i. p. 719.) Gooch fets down wounds of the pancreas as mortal, if its duct or blood-veffels be injured. Chr. Works, vol. i. p. 99.

Wounds of the kidneys and ureters are always dangerous, on account of the hemorrhage and effufion of urine. When the latter fluid infiluates itself within the peritoneum, or into the cellular membrane, the patient has but a very difcouraging chance of prefervation. Small wounds of the kidnevs, however, may be cured, though a fhifula will sometimes remain. The danger of wounds of the kidney is well pointed out in M. Hevin’s Essay on Nephroscopy, in the Mém. de l’Acad. de Chir., and a great mass of evidence is produced on the fubje&. The recoveries which Mr. Hennen has seen, after wounds of the kidneys, he observes, are very few indeed. "If the patient has survived the fift hemorrage, the fever and peritoneal inflammation, with inceffant hicouough and vomitng from sympathy of the diaphragm and fomach, have generally cut him off; and if he has for a time efcape, excruciating pains, profufe fuppuration from fistulous forses, hectic, and emaciation, have terminated his exiflence. Where the cure has been effected, there is reafon to think that the ureter has been but flietely bruifed, and the body of the kidney itself left untouched. The remedies confift in venecelion, mild purgatives, as anna, oil, &c. frequent emoilent enemas, the warm bath generally, and local fomentations, &c. with a diet of the mildest kind, but much refricted in fluids, the indulgence in which, even in small quantity, should be avoided." The fame author properly condemns all fufufus, billifers, and diuretics; and he recommends light dressings, fo as to allow the urine to escape freely. The integuments near the wound he also advifes to be greased, fo as to prevent the irritation of the urine from making them inflame and ulcerate. See Obf. on Military Surgery, p. 545.

The fubje& of wounds is one of infinite length, and this mudl apologize for the extent of the preſent article, in which a great deal is till omitted. Had we introduced a full account of the wounds of every part of the body, our obser- vations would have formed a production more than twice as long as that which we have now finifhed; but we thought that fo minute and elaborate a paper would hardly be defirable in a work not expressly allotted to the confeideration of surgery.

Wounds in Horses. The moft terrible wounds these creatures are fubje& to are thole got in the field of battle. The farriers that attend camps have a coarfe way of curing thefe; but it is a very expetidious and effectual one. If the bullet be within reach, they take it out with a pair of forceps; but if it lie too deep to be come at, they leave it behind, and dress up the wound in the fame manner as if it were not there.

They fift drop in some varnish from the end of a feather, and when the bottom is thus wetted with it, they dip a pledget of tow in the fame varnish, which they put into the wound, and then cover the whole with the following charge: Take a quarter of a pound of powder of bole armenic, half a pound of linseed-oil, and three eggs, shells and all; add to these four ounces of bean-flour, a quart of vinegar, and five ounces of turpentine; this is all to be mixed over the fire, and the wound covered with it. This application is to be continued four or five days, then the tent put into the wound is to be dipped in a mixture of turpentine and hog’s-lard; by this means a laudable matter will be discharged, instead of the thin sharp water that was at first. Then the cure is to be completed by dressing it with an ointment made of turpentine, firft well washed, and then dissolved in yolks of eggs, and a little faflron added to it.

This is the practice in deep wounds that do not go through the part; but in cafes where the bullet has gone quite through, they take a few weavers’ linen thumbs, made very knotty; these they make up into a kind of link, and dipping it in varnish, they draw it through the wound,
leaving the ends hanging out at each side; by means of these they move the link or sickle three or four times a day, always wetting the new part that is to be drawn into the wound with fresh varnish. They put on a charge of the bole armenic, &c. as before described, on each side of the wounded part, and continue this as long as the wound discharges thin watery matter, or the sides continue swelled. After this they dress it with the ointment of the turpentine, yolks of eggs, and saffron, till it is perfectly cured.

The other methods are, the dressing of the wound with an ointment made of wax, turpentine, and lard, and covering it with linen rags wetted with cream; or the dressing with a mixture of yolks of eggs, honey, and saffron, and covering it up with cream and bay-leaves beaten together.

When the wound is so dangerous as to require the affluence of internal medicines, they give the following pills: Take affafoetida, bay-berries, and native cinnamon, of each a pound; beat up the whole into a mass with brandy, and roll it into pills of fourteen drachms each. These are to be laid in a shady place to dry, after which they will keep forever long without any damage. The horse is to take two of these every other day, or, if necessary, every day, till he has taken eight or ten of them, and he is to stand bridled two hours before and after the taking of them.

When the wound seizes at a stand, not appearing foul, yet not gathering new flesh, there must be recourse had to the following powder, whose effect in bringing new flesh is wonderful: Take dragon’s blood, and bole armenic, of each two ounces; mastic oleum, and farcocola, of each three drachms; aloes, round birth-wort, and common iris-root, of each one drachm and a half; make the whole into a fine powder. This is sometimes used dry, sprinkling it on the wound; but sometimes it is mixed with turpentine, sometimes with juice of wormwood, and sometimes with honey of roses, and either way does very well.

When the wound grows foul, and requires a detergent to cleanse it, the common liquor for this purpose is a phlegedonic water, which they make of lime-water, and sublimate in this manner: Take two pounds and a half of newly-made and unflake lime, put it into a pewter vessel, and pour on it five quarts of boiling water. When the bubbling is over, let it stand to rest two or three days, stirring it often with a flick; then pour it clear off after due time for the lime to settle, and filter it through some whitened-brown paper, made for the lining of funnels, on this occasion. To a quart of the clear lime-water, thus prepared, add eight ounces of spirit of wine, and one ounce of spirit of vitriol; when these are well mixed, by shaking them together, then add an ounce of corrosive sublimate in fine powder: mix all well together, and keep the whole in a bottle, to be used for the cleansing of these foul wounds, and on any other occasions, where a detergent of this powerful kind may be necessary. It will keep good many years.

If this water will not thoroughly cleanse the wound, but there will remain a quantity of foul matter in it, and there is danger of a gangrene, they add to it as much armenic in fine powder as there was of the corrosive sublimate; that is, at the rate of an ounce to a quart and half a pint.

These are all the medicines which the farrier need carry with him on account of wounds; and they are all such as may be prepared at home, and will continue good so long as he has occasion to keep them, or much longer; and what is left of one year will serve for others.

When the necessary applications are thus settled, it may not be improper to add the general rules by which they conduct themselves in the cure:

1. The wound must be probed at first, but very gently, and afterwards as gently and as seldom as may be, for the horse’s flesh is the most eady of all others to be contused in wounded parts, and to fall into a gangrene from the hurt.
2. The wound must be kept continually as clean as possible, and free from proud flesh.
3. The necessary revulsion must always be made by bleeding, as soon as the wound is dressed the first time; this prevents inflammation, and a great many other bad accidents. 4. If the wound be in such a place that the horse can get at it with its tongue to lick it, great care must be taken to prevent his doing so, as it will greatly retard the cure. 5. The farrier never is to proceed to pappuration in any case in which the humours can be either dissolved or repelled, and especially in parts that are full of sinews and ligaments, or that are near the bones. 6. If a wound be accompanied with a great contusion, or if it be of a round or circular figure, incisions are often necessary about its edges, and sometimes the application of cauteries.
7. The wound must be always carefully covered, for the access of the air retards the cure. 8. The callous lips of a wound must always be cut to the quick, before they can be united together. These may serve for general rules, that hold good in all cases: and to these may be added some that are principally applicable to peculiar circum- stances of the wounds.

Wounds of the breast are to be cured with tents and folds of soft linen laid over them, steeped in the following mixture: Take verdigris, vitriol, and alum, of each one ounce; vinegar, eight ounces; honey, a pound; let all these be boiled together till they become red.

Wounds in the belly can only be cured by sewing up the peritoneum with strong woolen thread, not silk, leaving the extremities without the skin. The skin is to be sewed together with strong hempen thread waxed, joining the lips of the wound together, by this means, in form of a buckle. This is to be covered with the common ointment for wounds; and if an inflammation comes on, chalk dissolved in vinegar is to be added.

If the wound be such that the guts come out at it, the horse may still be recovered, if proper caution be used; the guts are to be immediately returned into their place; but they must not in this be touched with the hand, but with a sponge dipped in warm water. And, in order to the making them more readily get into their places, it is proper to make the creature vomit, by thrusting down his throat a feather dipped in oil. If the wound through which they fell is not big enough to return them easily by, it must be enlarged by cutting; but if the guts are found to be bruised or wounded, it is in vain to attempt any thing, for death must follow.

There is also a certainty of death when, after a wound of any kind in the belly, the horse voids blood at the fundament.

When a horse is wounded near the groin, he easily falls into convulsions; in this case, he is to be kept from drinking as much as possible; he is also to be covered well up, and kept quiet, and to have green things given him to eat.

Wounds on the knees are very difficult to cure, because the part is in motion almost continually, and there is very little flesh to work upon. When the wounds are but slight, and in the muscular parts of the body, a mixture of honey and tallow, boiled together, will often prove a cure; when the wound is more considerable, turpentine melted in a little common oil, and applied hot, is the general remedy.

If a wound happens between the thigh and the hoof, care must be taken that no foreign matter be left in it, and it must be drest with any of the ointments that have verdigris in them; and a charge of bruised elder-leaves is very proper.
proper to be applied over all. If the wound be deep and narrow, it must be enlarged at the orifice, and turpentine and wax, melted in lard, must be poured into it. The same rule of opening the orifice holds good in all deep and narrow wounds.

If a nerve happens to be cut, it must be closed, and a defensative must be applied, to prevent a concourse of humour to the part; a fomentation made of oil, wine, and honey, mixed together, is also very proper, wherever a nerve is hurt, and a poultice may be applied over all, made of marshmallow-roots boiled soft, with bread and milk.

If the horse happens to be wounded by a piece of wood, bone, or any other hard substance, part of which remains in the wound, this must be carefully taken out, whatever pain it may cost the creature to do it, and the wound must then be dressed with the common wound-ointments. In this, or any other case of a fresh wound, the washing it with oil of turpentine is an excellent method of preventing ill consequences.

Wounds in Trees, such as are caused in lopping and pruning their branches, or otherwise. Mr. Nichol, in his "Practical Planter," has shewn, that lopping of strong branches becomes not necessary, and that all woundling in pruning should be performed on or towards the extremities of boughs which have inferior laterals to partake of and divert their luxuriance of growth from injuring the stem or leader. It is also shewn, that from this mode little ill is to be apprehended, and consequently that the treatment of such wounds is simple, and which is so much the better for the plant and the interest of its owner. Such wounds require no other attention than being lopped clean off with a sharp knife or bill; and, if the saw is used, being afterwards smoothed with the knife. And it were to be wished, for the sake of much timber, which otherwise might have been rendered more valuable, that wounds of another description had been unnecessary, or had never been inflicted. The writer here alludes to the necessity of lopping by the bole all stumps, &c. occasioned by formerly-injudicious pruning, and the wanton folly of those who lop large branches by or near to the stem, when simply shortening them at a proper distance would answer a better purpose. But since it becomes necessary to clear formerly-injured trees of stumps, &c. in order to prevent farther decay, it also becomes a duty to follow the most rational and simple mode of treatment. With this view, it is briefly observed, that whenever it becomes necessary to lop a stump by the bole, or to shorten any branch larger than the wrist or ankle; in the former case, the wound should be to the quick, that is, to the level of the bark, on the stem at least; and in the latter, obliquely across the branch, so as, from its position, to prevent moisture from lodging; being careful to prevent laceration, by notching the bark underneath, before the amputated part falls down, or to one side. In both cases, the face of the wound and edges of the bark are to be made perfectly smooth with the knife; and in a few hours after, or so soon as they are quite dry, let the wound be carefully plattered with tar, (such as is used for sheep-smearing,) or laid over with white or blue lead, which has been well mixed up with oil, and rendered rather thicker than is commonly used for painting. The tar is, however, certainly preferable, being of a more healing nature; and if laid on in a thin state, it is not so apt to scale off by the action of the weather as the paint. This operation should be performed in the fall of the year; at which time, the wound is not so apt to crack, and likewise dries sooner than at any other season. If, however, in the course of the ensuing summer, or at any subsequent period, the tar or paint is found to rend or scale off, care must be taken to renew and keep the platter found and smooth, until the bark grow over and cover the wound; and this should be more particularly observed in respect of wounds on the trunk.

In the case of lopping a tree, lopping an upright branch, or in training for ship-timber, lopping the leader, &c. when, from the upright position of the wounded part in question, platterting or painting, as above, might be deemed insufficient to prevent water from penetrating, and of consequence injuring the wood at the part affected; yet by this treatment, infection, or the farther decay of the rest of the tree, will be prevented. But there are some who ridicule the idea of using platter of any kind, urging for argument that the bark grows as fast together of itself without this aid, and why bury in the heart of the tree a load of rubbish? But they certainly have not considered, that a decayed part of the vegetable being buried in its heart, cannot possibly again be renovated, or become found timber; but, on the contrary, must operate to the corruption of the rest. And this question, why bury in the tree a load of rubbish? leads, it is laid, to a decision in favour of using tar, since, besides that the body inclosed is quite thin, it is of a genial, healing nature, acts as a cement to the fracture, and afterwards becomes equally found as the wood.

And this may be demonstrated by examining fir-trees which have been wantonly hacked deeply, had holes bored into them for fastening gates to, which have afterwards been removed, and above all in the operation of extracting rosin; in all which cases, the wound is closed up by the refining juice of the tree, and generally becomes perfectly found as the rest of the wood, although a blemish may be the consequence. Wherefore, with respect to refining woods, nature prevents the necessity of our interference in the cure of wounds, other than the fracture of limbs; which is certainly our duty to amputate, in order to prevent farther decay and unfightly appearance; but she will hastily cover the wound with the platter superior to any we can prepare.

Wound-Wort, in Botany, the name given to several species belonging to different genera.

Wound-Wort of Achilles, See Achillea.

Wound-Wort, Clove's, a species of flachys. See Stachys.

Wound-Wort, Hercules' or All-head, the lasperpitum chironium of Linnaeus. This is a native of the warmer climates, and bears the colds of our own. Both the seeds and roots of this species are considerably warmer than those of the garden and wild partnep. The roots and stalks have a strong smell and taste, resembling those of opopanax: and Boerhaave relates, that on wounds the plant in summer, he obtained a yellow juice, which, being infused a little in the sun, agreed perfectly, in both respects, with that exotic gum-refin. Lewis. See Laserpitium.

Wound-Wort, Saracen's, solidago. See Solidago.

Wound-Wort, True Saracen's, a species of senecio. See Senecio.

WOUNICUS, in Geography, a town of Auffrian Poland; 32 miles E.S.E. of Cracow.

WOUTERS, FRANCIS, in Biography, was born at Lierre, in Brabant, in 1614. He was a student in the school of Rubens, but applied himself principally to landscape, and became one of the most eminent of his time. He chose for his models the scenes of his native country, and particularly the forest of Soignes, near Brussel; embellishing the views he chose with groups of figures representing historical or allegorical
allegorical subjects. Sometimes he attempted history, but not successfully. He was in favour with the emperor Ferdinand II.; but coming to England with his ambassador in 1637, he was appointed chief painter to the prince of Wales, afterwards Charles II. On the breaking out of the rebellion he returned to Antwerp, and became director of the academy there, where in 1659 he was killed by the accidental discharge of a gun.

**Wouvermans, Philip**, was a remarkable and melancholy instance of those mis-shapen and unhappy combinations of talent, industry, and ill-fortune, which have occasionally disgraced the world of connoisseurship. He was the son of an indifferent historical painter, and was born at Haerlem in 1620. Having obtained possession of his father's store of pictorial knowledge, he was placed with John Wynants, the landscape-painter, under whose instruction he soon acquired a considerable degree of power in embodying the creations of his own fancy, and to this acquisition he added much by an attentive study of nature.

There is but little known of his private life. Celebrity, which now attends his name, formed no part of his enjoyments; indeed they appear to have been few, and confined to his affection for and attention to his art and his family, which was numerous. His pictures, beautiful as they are, agreeable in their composition and colour, and exquisite in their finish, exhasted his time without raising him above indigence and obscurity. The more free, flight, and loose works of Peter de laer, called Bamboccio, absorbed the admiration of the Dutch collectors, while the elegant and delightful productions of Wouvermans remained unnoticed and unknown. Time has adjusted the balance, and the united voice of the tasteeful now sheds a lustre over the name of the latter; too late, alas! for his gratification or benefit.

The neglect which he endured, and the severity of labour required to complete so many pictures as he has left, in so high and perfect a degree of finishing, exhausted his health, and he died at the early age of 48; having burnt a short time before his death all his studies and drawings, to prevent, as he declared, his children from being induced to follow a profession which had been but a source of poverty and misery to himself.

The subjects of his pictures are drawn from the common scenes of nature, but are sometimes of a more elevated cast than those chosen by the generality of his compatriotes, particularly his hawkings and hunting, where cavaliers and high dames, with appropriate scenery, rich trappings to their horses, and numerous retinues, are introduced with great taste and propriety. His encampments and battles are composed with the same skill and suavity; indeed the latter is a principal characteristic of all his works, whatever be their subjects, from the humble hay-cart to the richest combination of materials which the gay palaces, its garden, and splendid adornments, afforded him. Farrow's shops, fairs of horses, travellers on their road, or at inn-doors, &c. &c. were equally rendered agreeable by his delightful arrangement of chiaro-ocuro and of colours, and by the exquisitely firm full touch with which they are executed. His works are numerous, and when in good preservation fell at very considerable prices.

**Wouvermans, Peter**, the younger brother of Philip, was also an artful of considerable talent, though by no means equal to him. He was also born at Haerlem, about the year 1625. He was trained under R. Rogman, but principally followed his brother's style, and adopted his chief subjects. But though his pictures are frequently found for Philip's, yet they are not so delicate or spirited, and may be easily distinguished from his by a cultivated eye. There was also another brother, a few years younger than Peter, who followed the same line of art with rather more talent; so that we cannot be surprised at the number of pictures which bear the name of Wouvermans. John died in 1666, at the age of 58.

**Woxen**, in Geography, a large and noisy current of Sweden, formed by the discharge of the lake of Saima into the Ladoga, which forms a vast cataract about a mile from its mouth.

**Woxna**, a town of Sweden, in Helsingland; 40 miles W. of Soderhamn.

**Woxtorp**, a town of Sweden, in the province of Smaland; 27 miles N.W. of Vexio.

**Woye**, a town of Germany, in the principality of Culmbach; 5 miles S.E. of Hof.

**Woytz**, a town of Silesia, in the principality of Neifes; 2 miles E. of Ottmachau.

**Wra**, a town of Sweden, in the province of Smaland; 48 miles W.S.W. of Vexio.

**Wrack**. See Wreck.

**Wrack**, in Natural History. See Wreck.

**Wrack**, in Agriculture, a name sometimes given to a marine plant, which is of great utility as a manure. With this plant surfenoses sometimes make a cathaplasm, by bruising a quantity of it, and applying it in cafes of scrofula, or white-swelling, but more particularly glandular tumours. Where this cannot be got, sea-water and oat-meal formed into a poultice have supplied its place. There is no reason why the tumours and ill-conditioned sores of brute animals should not be benefited by similar applications. See Wreck.

It is frequently termed sea-wrack, sea-tangle, and sea-oak. See Sea-Weed.

**Wragby**, in Geography, a small market-town in the wapentake of Wingrove, Lindsey division of the county of Lincoln, England, is situated at the junction of the turnpike-roads leading from Lincoln to Louth and Horncastle, and is distant 11 miles N.E. by E. from Lincoln, and 144 miles N. by W. from London. George Villiers, duke of Buckingham, who possessed this manor in the reign of Charles II., obtained, from that monarch a charter to hold a weekly market on Thursday and two annual fairs, which are now well frequented. Sir Edmund Turnor, who purchased the manor of the duke, erected and endowed an alms-house for six clergyman's widows, and six other delittute persons, for whose use he built a chapel, with an augmentation to the vicarage of 40l, per annum for prayers to be read in it twice every day: this chapel was consecrated by bishop Gardiner July 18, 1697. Here is also a free-school, founded and endowed in 1633 by William Hanford, esq. The population of Wragby is stated, in the return of the year 1811, to be 709; the number of houses 193. The manor is now possessed by Edmund Turnor, esq. who has a seat in the adjacent parish of Pantons, called Pantons-hall, which was built by Hawkmoor, a pupil of Sir John Vanbrugh, in the year 1724; considerable additions have been made to it from the designs of Mr. Carr, architect at York; and the adjoining country has been greatly improved by ornamental plantations. Two miles north of Wragby is Halton Lodge, the seat of colonel Caldicot, in whole family the manor of Halton has been vested for several generations.—Beauties of England and Wales, vol. ix. Lincolnshire; by J. Britton, F.S.A. 1808.

**Wraith-Bolts**, in Ship-Building, are iron ring-bolts, used when planking ships, &c. with two or more fore-lock holes near the end, for taken-in the fet, as the plank, &c. works nearer the timbers.

**Wraith-Strap**, a sort of stout billets of tough wood, tapered
tapered at the ends so as to go into the ring of the wraith, to make the jets necessary for bringing to the planks or thick fluff to the timbers.

WRAM, in Geography, a town of Sweden, in the province of Skone; 13 miles W.S.W. of Christianstad.

WRANGLER, Senior, a technical term in the university of Cambridge, for the student who passes the best examination in the fenate-hous, and confers lasting reputation. They who follow next in the same division are respectively termed second, third, fourth, &c. wranglers. In a similar manner, they who compose the second rank of honours are designated by the titles of first, second, third, &c. optimi. Those of the latter order are distinguished by the denominations of first, second, third, &c. junior optimi.

WRANGLON, in Geography, a small island in the gulf of Finland. N. lat. 59° 34'. E. long. 25°.

WRANNY, a town of Bohemia, in the circle of Schlan; 7 miles N.N.W. of Schlan.

WRANOW. See Fraun.

WRAPPER, in Botany. See Volva.

WRASSE, in Ichthyology, the name of a fish called by authors turdus vulgaris, and by some tinea-marina, the foot-fish, and sometimes old-wife.

The wraas, or labrus tinea of Linnaeus, resembles the carp in figure, and is covered with large scles. Its usual size is about five or six inches in length, and it grows to the weight of four or five pounds: its colour is very variable; red, yellow, or brownish, being very frequently mixed in the scales; and it has five or six longitudinal lines, alternately of a pale yellow, an olive colour, and a dusky red. Its nose is long, and bent upwards, and it has thick and flabby lips extended over the jaws. Its mouth is small, and its teeth, which are disposed in two rows, the first conic, the second very minute, are not very sharp; in the throat, just before the gullet, are three bones, two above of an oblong form, and one below of a triangular shape; with the surface of each rising into roundish protuberances: these are of singular use to the fish for grinding its flabby food before it arrives at the stomach; the dorsal fin consists of sixteen sharp and spiny rays, and nine soft; longer than the others; the pectoral fins are large and round, and composed of fifteen rays, the ventral of fix; the first sharp and strong; the anal of three sharp spines, and nine flexible: its tail is rounded at the end, and is formed of fourteen soft branching rays; the membranes of the fins and tails are variegated with red and blue spots, and the anterior rays of the back-fin are prickly. It is caught in plenty on the English shores, and is sold among the poorer sort of people in Wales and Cornwall; but it is esteemed a very delicate fish. It is found in deep water, adjacent to the rocks; it will take a bait, though its usual food is flabby-fish, and small crustacea. Willughby's Hist. Pisc. p. 320. and Pennant.

See Labrurus.

WRASSE, Bimaculated, labrus bimaculata of Linnaeus, has a body pretty deep, and of a light colour, marked in the middle on each side with a round brown spot, and another on the upper part of the bale of the tail: the lateral line is incurvated; the branchiologous rays are fix; the first fifteen rays of the dorsal fin are spiny, the other eleven soft, and lengthened by a flaky appendage; the pectoral fins consist of fifteen rays; the ventral of fix, the first spiny, the second and third ending in a slender bristle; the anal fin is pointed; the four first rays being short and spiny, the rest long and soft. This is an inhabitant of the Mediterranean.

Mr. Pennant has described some other species of wraas, as the trimaculated, trifiped, and gibbus, taken on the coast of Anglesea, and another called ballan, numbers of which appear during summer near Scarborough, which is of the form of the common wraas, except that between the dorsal fin and the tail it has a considerable finking; above the nose a deep fulcus; and on the farthest cover of the gills a depression radiated from the centre. Pennant's Brit. Zool. vol. iii. p. 246, &c. See Labrus.

WRATENI, in Geography. See Fratani.

WRATH, CAPE, a cape in the N.W. extremity of Scotland, in the parish of Durness, which affords excellent paffure for sheep. In its vicinity are vast caverns.

WRBOWALNOL, a town of Bohemia, in the circle of Konigingratz; 16 miles S.W. of Biezow.

WREAK, or WREEK, a river of Leicestershire, which falls by Melton Mowbray, and runs into the Soar, 7 miles N.E. of Leiceter.

WREATHE, in Agriculture, a small roll formed of any kind of light substance, such as straw, hay, &c. and used for different purpofes.

WREATH, in Natural History. See Turbo.

WREATH, in Heraldry, a roll of fine linen, or silk, like that of a Turkish turban, consisting of the colours borne in the escutcheon; placed in an achievement, between the helmet and the crest, and immediately supporting the crest.

WREATH, Stick-Band, in Agriculture, a band formed of any kind of twisted flack, used for tying up fagots, and other such purpofes.

WRECK, Wreck, Sea-Wreck, or Sea-Oak, the fucus vesiculosus of Linnaeus, in Natural History, a foft, very flippery, marine plant, common among rocks that are left dry at the ebb tide, with leaves somewhat resembling those of the oak-tree; the stalk running along the middle of the leaves, and terminated by watery bladders containing either air or a flippery fluid; the vehicles begin in March to fill with a thin juice; and about the end of July they burft, and difcharge a matter as thick as honey.

In some places it is used to manure the ground. In Normandy, and other parts, they burn it; and of the ashes make a kind of soda, or potash, which they ufe in the making of common green glass, to promote the fusion or vitriolisation of the other materials. See Sea-Weed.

Dr. Ruffel relates, that he found this plant an ufeful affiftant to sea-water in the cure of diforders of the glands; that he gave it in powder to the quantity of a drachm, and that in large doses it aoubted the stomach; that by burning in the open air, it was reduced into the black famine powder; which feemed, as an internal medicine, greatly to excite the officinal burnt sponge; which was beneficially ufed as a dentifrice, for correcting laxities of the gums; and which indicated a remarkable degree of detergent virtue by its effect in cleaning the teeth: that the juice of the vehicles, after standing to putrefy, yielded, on evaporation, an acrid pungent falt, amounting to above a fropule from two fpondeons; that the putrefied juice, applied to the skin, in immediately, excites a flight flene of pungency, and deters like a solution of foap; that one of the best applications for diffusing hardnefs, particularly in the decline of glandular swellings, is a mixture of two pounds of the juicy vehicles, gathered in July, with a quart of sea-water, kept in a glafs vefel for ten or fifteen days, till the liquor comes near to the confiquence of very thin honey; the parts affected are to be rubbed with the strained liquor twice or thrice a day, and afterwards washed clean with sea-water. Lewis's Mat. Med. See AETHIOPIS Vegetabilia.

WRECK, in Sea Language, denotes the ruins of a ship which had been stranded or dashed to pieces on a shelf, rock, or lee-shore, by tempestuous weather.
WRECK, Wreckum, called also Ship-Wreck, or Ship-Wrack, in Law, &c. is when a ship perishes in the sea, and no man escapes alive out of it.

The civilians term it naufragium. The goods in the ship which are brought to the land by the waves belong to the king, or him to whom he affigns the right thereof. Thus, in the Stat. Prærog. Reg. 17 Edw. II. cap. 11. " Rex habebit wrecum mari per totum regnum, balenam et flurgonias captas in mari, vel alibi intra regnum, exceptis quibuslibet privilegiatis locis," &c.

Thus also the matter flowl by the ancient common law; but the rigour of the law of wrecks has been gradually softened in favour of the distressed proprietors. Accordingly it was first ordained by king Henry I. that if any person escaped alive out of the ship, it should be no wreck; and afterwards king Henry II. by his charter, May 26, A.D. 1174, declared, that if on the coasts of England, Poitou, Oleron, or Gascony, any ship should be distrefled, and either man or beast should escape or be found therein alive, the goods should remain to the owners, if they claimed them within three months; but otherwise she should be deemed a wreck, and belong to the king, or other lord of the franchise.

This was again confirmed, with improvements, by Richard I., who, in the second year of his reign, not only established these concessions, by ordaining that the owner, if he was shipwrecked and escaped, "omnes res suas liberas et quietas habaret," but also, that if he perished, his children, or, in default of them, his brethren and sisters, should retain the property; and in default of brother or sister, then the goods should remain to the king. And by the law, as laid down by Bracton in the reign of Henry III., if not only a dog (e.g.) escaped, by which the owner might be discovered, but if any certain mark were set on the goods, by which they might be known again, it was held to be no wreck. Afterwards, in the statute of Welfam, 1, 3 Edw. I. cap. 4, the time of limitation of claims, given by the charter of Henry II., is extended to a year and a day, according to the usage of Normandy; and it enacts, that if a man, a dog, or a cat, escape alive, the vessel shall not be adjudged a wreck. And it is now held, that not only if any living thing escape, but if proof can be made of the property of any of the goods or lading which come to shore, they shall not be forfeited as wreck. The statute farther ordains, that the sheriff of the county shall be bound to keep the goods a year and a day, (as in France for one year, agreeable to the maritime laws of Oleron, and in Holland for a year and a half) that if any man can prove a property in them, either in his own right or by right of representation, they shall be restored to him without delay; but if no such property be proved within that time, then shall be the king's. If the goods are of a perishable nature, the sheriff may sell them, and the money shall be liable in their stead. This revenue of wrecks is frequently granted out to lords of manors, as a royal franchise; and if any one be thus entitled to wrecks, in his own land, and the king's goods are wrecked thereon, the king may claim them at any time, even after the year and the day. In order to constitute a legal wreck, the goods must come to land. If they continue at sea, the law distinguishes them by the barbarous appellations of jefam, flatam, and ligan.

Wrecks, in their legal acceptance, are now not very frequent; the owner being seldom unable to assert his property within the year and day limited by law. And in order to preserve his property entire, our laws have made many humane regulations, very opposite in their spirit to those which formerly prevailed in all the northern regions of Europe, and a few years ago were still paid to subsist on the coasts of the Baltic sea; permitting the inhabitants to seize on whatever they could get as lawful prize. To what the reader will find under Salvage to this purpose, we shall here add, that all persons who receive any goods of a wreck shall forfeit their treble value; and if they willfully do any act whereby the ship is lost or destroyed, by making holes in her, stealing her pumps, or otherwise, they are guilty of felony without benefit of clergy. Moreover, by the statute 26 Geo. II. cap. 19, the plundering of any vessel either in distress, or wrecked, whether any living creature be on board or not, or the preventing the escape of any person that endeavours to save his life, or the wounding of him, with intent to destroy him, or the putting out of false lights in order to bring any vessel into danger, are all declared to be capital felonies, in like manner as the destroying of trees, slips, or other flated sea-marks, is punished, by 8 Eliz. cap. 13, with a forfeiture of 100l., or outlawry. Also by the statute of Geo. II. the pilfering of any goods cast adrift is declared to be petty larceny; and many other salutary regulations are made for the more effectually preserving ships of any nation in distress.

By the civil law, to destroy persons ship-wrecked, or prevent their saving of the ship, is capital; and to steal even a plank from a vessel in distress, or wrecked, makes the party liable to answer for the whole ship and cargo. The laws also of the Vifigoths, and the most early Neapolitan constitutions, punished with the utmost severity all those who neglected to afford any ship in distress, or plundered any goods cast on shore. Blackft. Com. book i. p. 291. &c.

In divers charters and old writings, it appears that wreck, anciently, not only comprehended goods which came from a perishing ship, but whatever else the sea cast upon land: whether it were precious stones, fish, sea-weed, or the like.

This wreck, in the Grand Customary of Normandy, cap. 17, is called varrec, and latinized verisum; and in some of our ancient charters, verecex, verge, vergeh, and seupwerp, q. d. sea-upwerp, of sea and upwerpen, to cast up.

Shipwreck, in maritime insurance, and as it concerns the right of abandonment, is generally a total loss. What may be saved of the ship or goods is so uncertain, and depends so much on accident, that the law cannot distinguish this from the absolute destruction of the whole. The wreck of the ship may remain, but the ship is lost. Thus also the goods may remain; but if no ship can be procured, in a reasonable time, to carry them to their place of destination, the voyage is lost, and the adventure frustrated. But the mere stranding of the ship is not, of itself, deemed a total loss, so as to intitle the injured immediately to abandon. It is only where the stranding is followed by shipwreck, or in any other way renders the ship incapable of proceeding her voyage, that the injured is intitled to abandon. If the voyage be lost, this is a total loss, not only of the ship and freight, but also of the cargo, if no other ship can be procured to carry it to its port of destination. Moreover, if a cargo be damaged in the course of the voyage, so that what has been saved is less in value than the amount of the freight, this is certainly a total loss. In case of shipwreck the rule in France is, that the injured may abandon, through the goods be recovered and carried to their place of destination, because goods thus saved are generally in a bad and unmarketable condition. But if the ship become unmanageable, the injured cannot abandon the goods, if by any other ship they may be conveyed in time to their place of destination.
As it is reasonable and necessary that the time of the underwriter's responsibility should be limited, this limit is fixed in some maritime states on the continent, within which period after the loss the injured may abandon. In France, Spain, and Holland, the times are limited by law, according to the distance of the place where the loss happens, within which the abandonment must be made. In England there is no time, limited by law, for abandoning; but the courts have adopted a rule better suited to the promotion of commerce, and more likely to prevent frauds, which is this: that as soon as the injured receives advice of a total loss, he must make his election whether he will abandon or not; if he determines to abandon, he must give the underwriters notice of this "within a reasonable time" after the intelligence arrives; and any unnecessary delay in giving this notice will amount to a waiver of his right to abandon; for unless the waiver does some act signifying his intention to abandon, it will be only a partial loss, whatever may be the nature of the cause, or the extent of the damage. If by any interference of the underwriters the injured be actually prevented from abandoning, the underwriters are liable for all the losses sustained by the injured to the extent of the sum insured. If the injured determine to abandon, and demand as for a total loss, he is not obliged, as in some foreign countries, to make a formal protest, but merely to give notice of the loss to the underwriters, and of his determination to abandon. The notice of abandonment may be given, either to the underwriter himself, or to the agent who has subscribed for him; and the abandonment ought to be made for the whole of the effects insured, and not for a particular part. The abandonment must be in good and unconditional; otherwise it will not transfer the entire property to the insurers, which is the essence of the abandonment. By the abandonment, the injured yields up to the insurers all his right, title, and interest in the ship or goods insured, or what may be saved of them, which, from the notice of abandonment, become the property of the insurers; but the abandonment of the ship does not, as in France, transfer to the insurer the freight he has earned. The abandonment not only intitles the underwriters to all that can be saved of the effects insured; but if compensation be made to the injured for the injury from which the loss arose, this compensation shall go to the underwriters; for when they have paid the loss, they, and not the injured, are the real sufferers. If the ship, after abandonment, arrive safe, the insurers shall have all the profit of the voyage. Nor shall they, on account of the safe arrival of the ship, refuse to pay the sum insured. So if the ship or goods insured happen to be recovered undamaged, after the insurer has paid a total loss, the insurer cannot compel the injured to refund the money, and take back the ship or goods, but the insurer shall stand in his place, and shall have the benefit of salvage. An abandonment once properly made, on sufficient ground, and accepted by the insurers, is absolute and binding upon both parties, and cannot be revoked unless by mutual consent; but if the ground be insufficient, it will be void. In case of shipwreck or other misfortune, the effects that are saved continue till abandonment, the property of the injured, who is bound in justice, honour, and confidence, to use his utmost endeavours to make the most of what may be rescued from destruction; in order, as much as possible, to lighten the burden of the sufferers. To enable him to do this, without prejudice to his right of abandonment, our policies provide, that in case of any loss or misfortune to the injured, their factors, servants, or assigns, shall be at liberty to sue, and labour about the defence, safeguard, and recovery of the goods and merchandizes, and

ship, &c. without prejudice to the insurance; "to the charges whereof, the insurers agree to contribute, each according to the rate and quantity of his subscription." Marshall on Insurance, vol. ii. See Perils of the Sea.

WRECK, in Agriculture, a term signifying the weeds thrown up by the floods upon the sea-shores; also the dead indigested roots and items of grasses, and other plants in ploughed lands.

WREKIN, in Geography, a mountain of England, in Shropshire; about 10 miles E. of Shrewsbury.

WREME, a town of the duchy of Bremen; 5 miles N.N.W. of Carlzburg.

WREN, Sir Christopher, in Biography, an eminent architect and mathematician, was born in 1632, at the living of his father, who was rector of Earl Knolly, in Wiltshire, and finished his education at Wadham college, Oxford, into which he entered in 1646. Before this time, he had given proofs of genius by the invention of astronomical and pneumatic instruments; the former of which he dedicated to his father, at the age of 15, in a copy of elegant Latin verses, together with an exercitium "De Ortu Fluminum." He also distinguished himself by the construction of other philosophical instruments; and in 1647 he wrote a treatise on Spherical Trigonometry upon a new plan. In 1650 he graduated B.A., and in 1651 wrote an algebraical tract on the Julian period. In 1653 he was elected fellow of All-Souls' college, and graduated M.A. He was one of the first members of the Philosophical Society at Oxford, from which proceeded the Royal Society, and contributed by his experiments and inventions to the advancement and instruction it afforded; and in 1663 he was elected a fellow of the Royal Society. In 1657 he was chosen astronomical professor at Gresham college; but upon being appointed Savilian professor of astronomy at Oxford, he resigned the former office, and in 1661 returned to the university, which created him doctor of laws. Wren next prefixed himself to our view as a pre-eminent architect; and thus distinguished, he received a commission in 1663 to prepare designs for the repair of St. Paul's cathedral; and after his return from a tour to France in 1665, with a view to his improvement in architecture, he finished those designs; but whilst they were under consideration, the edifice was destroyed by the fire of London in 1666. This catastrophe afforded him an opportunity of designing and constructing a building altogether new. The contemporary destruction of 50 parochial churches and many public buildings furnished ample scope for the exercise of Wren's talents; and he would have had the honour of redeeming, as it were, a new city, if the design which he laid before the king and parliament could have been accomplished without infringing on the rights of private property. On the death of Sir John Denham in 1667, he succeeded to the office of surveyor of the works; and in order to obtain leisure for executing the various works in which he was employed, and more particularly the rebuilding of St. Paul's cathedral, he resigned his Savilian professorship in 1673. In 1674 he received the honour of knighthood, and in the following year the foundation of the new cathedral was laid. For a particular account of this magnificent
magnificent edifice, see the article London. In 1680 Sir Christopher's scientific merits caused him to be elected president of the Royal Society. In 1683 he was appointed architect and commissioner for Chelsea college, and in the following year comptroller of the works in the castle of Windsor. In 1685 he was introduced into parliament as a representative of Plympton. To his other public trusts were added, in 1698, that of surveyor-general and commissioner for the repair of Westminster abbey; in 1699 that of architect of Greenwich hospital, and in 1708 that of one of the commissioners for the 50 new churches proposed to be erected in and near the city of London. Having fulfilled all his duties to the 86th year of his age, the administration of 1718 incurred indelible disgrace, by suffering political consideration to have such influence as to deprive him of his place of surveyor to the royal works. The remaining five years of his life were spent in honourable retirement, and devoted to scientific pursuits, and the reading of the Scriptures. It is said that he indulged a very picaresque vanity by being carried once every year to survey St. Paul's cathedral. His life was prolonged to his 91st year, and terminated in consequence of a cold which he caught in coming from Hampton-Court to London, in February 1723. His remains were interred, with suitable funeral honours, under the choir of St. Paul's, and upon his tomb is a concise but very appropriate and expressive Latin inscription, ending "Lector, si monumentum requiris, circumspice." Sir Christopher was twice married, and left one son, a man of learning and piety, and a good antiquary. The edifices constructed by Wren were mostly public, including a royal hunting-seat at Wincetster, and the modern part of the palace at Hampton-Court. Some of the most remarkable, besides St. Paul's, are, the Monument, the theatre at Oxford, the library of Trinity college, Cambridge, the hospitals of Chelsea and Greenwich, and of Christ Church, London, the church of St. Stephen, Walbrook, those of St. Mary-le-Bow, St. Michael, Cornhill, and St. Bride, distinguished by their turrets, and the great campanile of Christ Church, Oxford. Of the rank which he occupied as a man of science, we may form some judgment from the succeeding concise detail of his performances, and more particularly from the testimony of Sir Isaac Newton, who, in his "Principia," joins the names of Wren, Willis, and Huygens, and characterizes them as "hujus aetas Geometrarum facile principes." As to his moral character, it is said to have been worthy of his intellectual eminence; as with great equanimity, he was pious, temperate, modest, and communicative of his knowledge; and few men seem to have been more generally esteemed by their contemporaries. With regard to his architectural skill and attainments, a very competent judge, being himself of the profession, says, that he possessed an inextinguishable fertility of invention, combined with good natural taste and profound scientific knowledge; and that his talent was particularly adapted to ecclesiastical architecture, which afforded domes and towers to his picturesque fancy; while, in his palaces and private houses, he has sometimes sunk into a heavy monotony, as at Hampton-Court and Winchester. Among the rich variety of Wren's towers, turrets, spires, and domes, many are truly elegant. The church of St. Stephen's, Walbrook, exhibits a deviation from common forms equally ingenious and beautiful. The Monument is grand and simple. At Greenwich, his additions to the original work of Inigo Jones are singularly grand and beautiful. Upon the whole, Sir C. Wren's architecture is perhaps the perfection of that modern style which, with forms and modes of construction essentially Gothic, adopts for the decorative part the orders and ornaments of antiquity. Biog. Brit. Walpole's Anecd. Gen. Biog.

Wren, or Jenny-Wren, in Ornithology, the passer trochilidae of Gmelin, and the motacilla trochilidae of Linnaeus, has the head and upper part of the body of a deep reddish-brown; above each eye is a stroke of white; the back, and coverts of the wings and tail, are marked with slender, transverse, black lines; the quill-feathers with bars of black and red; the throat is of a yellowish-white; the belly and sides crossed with narrow dusky and pale reddish-brown lines; and the tail is crossed with dusky bars. Pennant.

This bird, though very small, is of a very cheerful disposition, and has a very agreeable voice, which he throws out with great cheerfulness and spirit, usually cocking up his tail all the time he is singing, and continues his song through the winter, except during the frosts. See Song of Birds.

The female breeds twice in the year, first in the latter end of April, and afterwards in the middle of June. The nest is usually placed among clusters of moss and ivy, in such a manner that it is very hard to discover it. It is made of dry moss and leaves put together in a very artificial manner, being closed all round except for a small hole left to go in and out at. They lay a great number of eggs, not less than eighteen; and it has often been found that they all hatch except one or two; and thus sixteen young ones have been found together in the nest. These are brought up so well as to shift for themselves by the end of May; and then another brood is provided for by the middle of the month following. The young ones may be easily raised. They should for this purpose be taken out of the nest at about fourteen days old, and fed with sheep's, calf's, or ox's heart, cut small, with eggs minced among it. When they are able to peck this meat for themselves, they may be put into cages; but they must still be fed for some days, lest they should neglect themselves, and die of hunger after the greatest part of the trouble is thus over. See Motacilla Trochilidae.

When they are grown up, they may be fed with paste, and will need no more heart. Afterward it will be a great feast to them to give each a spider or two at one in two or three days; and after they attain full age, they may either be left to find their own wild notes, which are very agreeable, or if it be desired that they should whistle tunes, they will easily be taught it. Ray and Pennant.

Wren, Crested, or Golden-Crested Wren, regulus cristatus, or motacilla regulus of Linnaeus, the name of a very beautiful little bird, the smallest of all the British birds. Its whole weight is not more than seventy-fix grains; and the crown of its head is adorned with a very beautiful fawn-coloured or orange-red spot, which is called its crest, and by some its crown, and from this golden crest the bird has obtained the name of the regulus, tyrannus, basilus, and other appellations of royalty. This beautiful fanet mark on the head is bounded on each side by a fine yellow line. The bill is dusky; the feathers of the forehead are green; from the bill to the eyes is a narrow white line; the back and hind part of the neck are of a dull green; the coverts of the wings dusky, edged with green, and tipped with white; the quill-feathers and tail dusky, edged with pale green; the throat and lower part of the body white, tinged with green; the legs are of a dull yellow colour; and the claws are very long.

This bird frequents woods, and is found principally in oak-trees. It is common about the Peak in Derbyshire, and is seen in autumn as far north as the Shetland isles, but quits that country before winter. It lays six or seven eggs,
not larger than peas. This bird has been observed suffused in the air for a considerable time over a bush in flower, whilst it sings very melodiously. The note does not much differ from that of the common wren, but is very weak. Ray and Pennant. See Motacilla Regularis.

WREN, Yellow. See Luteola, and Motacilla Tricolor.

WRENCH. See STRAIN.

WRENTWAM, in Geography, a town of the slate of Massachusetts, in the county of Norfolk, containing 2478 inhabitants; 23 miles S.W. of Bolton.

WRESTBALKING, in Agriculture, the operation of turning over upon or covering a balk or rib of whole unMOVED ground, by a broad furrow-slice, in the view of rendering the land more mellow and porous. The term is chiefly used in the eastern districts of the country.

WRESTLING, a kind of combat or engagement between two persons unarmed, body to body, to prove their strength and dexterity, and try which can throw his opponent to the ground.

Wrestling, palaestra, is an exercise of very great antiquity and fame. It was in use in the heroic age; witnesses Hercules, who wrestled with Anteus.

It continued a long time in the highest repute, and had very considerable rewards and honours assigned it at the Olympic games. It was the cullom of the athletes, or wrestlers, to anoint their bodies with oil, to give the lefs hold to their antagonist. See PÆLAESTRA.

Abolancourt observes, that Lycurgus ordained the Spartan maids to wrestle in public, quite naked, to break them of their too much delicacy and niceness; to make them appear more robust, and familiarize the people, &c. to such nudities.

A wrestling match, or neobering, is a very common diversion in the Mandingo countries of Africa. It is exhibited at the "Bentang," which is a large fage found in each town, that answers the purpose of a public hall or town-house: it is composed of interwoven canes, and is generally sheltered from the sun by being erected in the shade of some large tree. It serves also for a kind of lounging place, where the indolent and unemployed assemble to smoke their pipes, and talk over the news of the day.

At the wrestling match, the spectators arrange themselves in a circle, leaving the intermediate space for the wrestlers, who are strong, active, young men, trained up from infancy to this sort of exertion. Being stripped of their clothing, except a short pair of drawers, and having their skin anointed with oil, or figea butter, they approach each other on all fours, parrying with and occasionally extending a hand for some time, till at length one of them springs forward and catches his rival by the knee. Great dexterity and judgment are now displayed; and the contest is at length decided by superior strength. The combatants are animated by the music of a drum, which serves also in some measure to regulate their motions. The wrestling is succeeded by a dance, in which many performers assist, all being provided with little bells fastened to their legs and arms; their motions being regulated by the drum, beaten by a crooked stick, which the drummer holds in his right-hand, occasionally using his left to deaden the sound, and thus vary the music. The drum is also used to keep order among the spectators; and when the wrestling match is about to begin, the drummer strikes what is understood to signify "all be fee," fit all down; upon which the spectators immediately seat themselves; and when the combatants begin, he strikes "amuta, amuta," i.e. take hold, take hold.

Vol. XXXVIII.
of Sir Watkin Williams Wynn, bart. The road runs through an avenue of trees of uncommon growth, in a straight line for a mile, to a spacious lawn, on which stands the house. Erected at different periods, and in different styles of architecture, Wynnstay-hall is more distinguished for size and irregularity than for beauty of architecture. The new parts erected by the first baronet, although only a portion of the design, form a plain, substantial, comfortable place of residence; the older parts are chiefly appropriated to menial purposes. The interior comprehends some spacious apartments, in which are a few valuable portraits, particularly one by Vandyke of Sir Richard Wynn, who attended Charles I. on his romantic matrimonial adventure to Spain. Adjoining to the house is a small building, formerly used as a theatre. The park, from the ancient intrenchment Wat's Dyke which traverses it, was formerly called Wat-ray; but when the heirs married Sir John Wynn, who inclosed the grounds in 1678 with a stone-wall, the name was changed to its present appellation. The grounds are not greatly diversified, but they are well wooded, and favourably situated for prospects. On an eminence stands a fluted stone column, 100 feet high, on a plinth 16 feet square, accessible to the summit by an internal stair-case. It was erected in memory of the late baronet by his mother, with this simple but eloquent inscription: "Filio optimo mater cheu! superetes." Near the park the River Dee winds through Nant-y-Belan, or the dingle of the Marten, a place of great natural romantic beauty. Caer-iddin in this parish, commonly called Gartlicca, is a strong British fort on a lofty hill, at no great distance from Offa's Dyke. It is formed by a rampart and ditch, in some parts double, and the inner consisting of a thick wall. The area, containing about four acres, exhibits vestiges of ancient buildings.—Beauties of England and Wales, Denbighshire, by the Rev. J. Evans, 8vo. London, 1812.

WRIETZEN. See Brietzien.

WRIGHT, Edward, in Biography, an English mathematician, flourished in the latter part of the 16th and beginning of the 17th century. Of his private history little is known, except some few particulars that may be collected from the Latin memoirs of his life, preferred among the annals of Gonville and Caius college in Cambridge. This year (1615) died, it is said, at London, Edward Wright, of Carvelton in Norfolk, formerly a fellow of this college, much respected for the integrity and simplicity of his manners, and also famous for his skill in the mathematical sciences. He was the first undertaker of the difficult but useful work, by which a little river is brought from the town of Ware, in a new canal, to supply the city of London with water; but by the tricks of others he was prevented from completing it. Nor was he inferior to the most ingenious machine in the construction of instruments, either of brass or of any other matter. He, it is said, taught Iodocus Hondius the method of constructing his geographical charts, though Hondius concealed his name, that he might arrogate to himself the honour of the invention. Of this act of injustice, Wright complained in the Preface to his "Treatise of the Correction of Errors in the Art of Navigation," a work composed with excellent judgment, and after long experience, to the great advancement of naval affairs. For his improvement of this art he was appointed mathematical lecturer to the East India Company; and he read lectures, for which he was allowed a yearly salary of 5£. This office he discharged with great reputation, and much to the satisfaction of his hearers. He published, in English, a book on the doctrine of the sphere, and another concerning the construction of sundials. He also prefixed an ingenious preface to the learned Gilbert's book on the loadstone. By these and other writings he transmitted his fame to the latest posterity. It is added, whilst he was a fellow of this college, he was called forth to the public business of the nation by the queen, about the year 1593, or, according to other accounts, 1589. He was ordered to attend the earl of Cumberland in some maritime expeditions; of one of which he gave a faithful account, under the form of a journal or ephemeris, prefixed to it an elegant hydrographical chart of his own invention. His pollihumous work, which was an English translation of the book of logarithms, then lately discovered by Lord Napier, a friend of Mr. Wright, was published soon after his death by his son Samuel Wright, a scholar of the above-named college.

Death prevented the execution of several other designs which he had formed. Of him it may be truly said, that he studied more to serve the public than himself; and though he was rich in fame and in the promises of the great, he died poor, to the scandal of an ungrateful age. To the preceding extracts from the memoirs above cited, we may add, that Mr. Wright first discovered the true method of dividing the meridian line, according to which Mercator's charts are constructed (see Chart), and upon which his failing is founded. An account of it was sent from Cambridge to Mr. Blondeville, who published it among his exercises in 1594; and in 1597 a demonstration of it was given by the Rev. Mr. William Barlowe, in his "Navi- gator's Supply." In 1599 Mr. Wright published "The Correction of certain Errors in Navigation," written many years before, and shewing the reason of his division of the meridian, the manner of constructing his table, and its use in navigation, &c. &c. In 1610 he dedicated a second edition to his royal pupil, Prince Henry, with farther improvements, and an excellent method for determining the magnitude of the earth. To his other works, comprehending an account of his various discoveries, tables, and improved instruments for observation, we shall add his tract on navigation, entitled "The Haven-finding Art." It is said that he constructed, for the use of Prince Henry, a large sphere with curious movements, serving by spring-work to exhibit the motions of the whole celestial sphere, the particular systems of the sun and moon, their circular motions, places, and possibilities of eclipsing each other. (See Orrery.) This sphere was overlooked in the time of the civil wars, and found among dust and rubbish in 1646 by Sir Jonas Moore, who was at the expense of restoring it to its original state, and deposited it at his own house in the Tower, among other mathematical instruments. Preface to Robertson's Navigation. Hutton's Math. Dict.

WRIGHT, Richard, was a native of Liverpool, and born about the year 1735. He was bred to the humble occupation of a house and ship painter, but exerted his talents in painting sea views, and obtained for his encouragement the premium offered in 1764 by the society for the encouragement of arts, &c.; and in 1766 he gained another premium of fifty guineas, for a picture which had the greater credit of being most beautifully engraved by Woollett, and is known under the name of the "Fihery." He died about 1775.

WRIGHT, Joseph, one of our earliest painters of celebrity in this age of refolition of the art. He was born at Dartmouth in 1701, and thence obtained the name of Wright of Dartmouth, in distinction from R. Wright mentioned above. He came to London to study with Hudson, but afterwards established himself at his native place, and had very con-
siderable encouragement as a portrait-painter, though his
style was dry and too minute. He gained much more re-
putation by painting scenes of fire and candle-light, and
indeed flood unrivalled in that way till Louthembourg subse-
quentiy appeared. His pictures of a forge and of a black-
smith’s shop, exhibited with the society of artists about the
year 1765, established his reputation. In 1773 he visited
Rome, and Italy generally, and was absent two years. In
1782 he was elected an associate of the Royal Academy, but
refused his diploma soon after, on Mr. Garvey’s being pre-
ted to him in an election for an academician; though he
continued occasionally to exhibit with the academy. He
had great industry and professional skill, living very much
apart from the world. This enabled him to produce many
pictures, and in 1785 he made an exhibition of twenty-four
pictures of his own painting at the great room under the
Piazza Covent-garden, one of which was a large work re-
presenting the destruction of the floating batteries before
Gibraltar. His style in all his works was peculiar to him-
self, somewhat dry, yet not void of richnesses, and his draw-
ing coldly correct. One peculiarity marks his pictures, and
renders them easily distinguishable, especially those in which
the illumination proceeds from the moon or fire. He pre-
pared his clothes or grounds with rough surfaces, caused by
fand sifted or strewed upon them; and then when he had
painted his scene, he dragged his palette-knife, covered with
the colour of the light, across the picture, when the colour
adhering to the projections on the surface, gave the glitter
which characterizes that kind of illumination, and he toned the
parts to due relief by glazings. No one ever gave the
exact tone of moon-light so completely as Wright of Derby.
He died in 1797, aged 63.

Wright, M. J., a vocal apprentice to Michael Arne, the
natural son of Dr. Arne. She had a sweet, spirited, and
active voice, but was so young in music, that she learned the
parts which she had to perform on the flute, after she
was too halfingly engaged at Drury-lane, by her ear. The
first part assigned to her in that theatre was Leonora, in
Bickerstaff’s Padlock, in which the airs, as set by Dibden,
were so pleasing, and so much on the Italian model, that
they established her in the favour of the town. But the air
“Say little foolish fluttering thing” was never sung in such
a brilliant and captivating manner by any other singer.

In 1766 she appeared in the Cunning Man, Roufeu’s
Devon de Villege, translated totidem jullais, and adapted to
his original music by the author of this article, in which
she pleased extremely.

Soon after this, the apprentice was exalted into the wife
of her master, the Sera padrona, and sung with great apla-
use in Cymbon, and several of his and other composers’
compositions that were performed at Drury-lane; and, if
we remember right, in the summer she sung in Mary-le-bone
gardens. But the town was so fond of hearing her, and
the share of her talents so alluring to her husband, that
she may truly be said to have sung herself to death; or, like
the swans of old in the Po, to have died singing. The true
is, that her ignorance of music made it necessary for her
to sing at home, in rendering herself perfect in her parts,
ten times more than she did in public, which brought on a
pulmonary complaint, and prematurely put an end to her
existence in 1779, at the age of 23, to the grief of her
friends, and great regret of the public.

Wright, in Geography, a town of Virginia; 44 miles
W. of Richmond.

Wright’s Town, a township of Pennsylvania, in the
county of Bucks, with 562 inhabitants; 24 miles N. of
Easton.

WRIGHTIA, in Botany, is dedicated by Mr. Brown to
his much-respected friend William Wright, M.D. fellow
of the royal societies of London and Edinburgh, and asso-
ciate of the Linnean society, “who whole ardour in the pur-
suit of botanical knowledge,” says Mr. Brown, “even while
engaged in extensive medical practice in the island of Ja-
maica, has long entitled him to this mark of distinction.”

We heartily concur in this sentiment, and cannot but regret
that Dr. Swartz did not retain for this purpose what he has
called MERIANA. (See that article.)—Brown in Tr. of the
Ait. Hort. Kew. v. 2. 68. (Nerium; Georr. t. 117.)—
Chals and order, Penicetria Monogynia. Nat. Ord. Con-

Gen. Ch. Cat. Perianth inferior, of one leaf, in five
small, rounded, bluish segments, with five or ten internal
scales at the outside of the base of the corolla, permanent.
Cor. of one petal, falver-shaped; tube cylindrical, various
in length; limb in five oblong, spreading, oblique segments,
as long as the tube, or longer; mouth crowned with ten
divided scales, shorter than the limb. Stam. Filaments five,
thread-shaped, short, inserted into the throat of the corolla;
thers arrow-shaped, pointed, prominent, cohering by their
middle part to the stigma. Pffl. Germs two, superior,
roundish, cohering; style one, thread-shaped, the length of
the tube, dilated at the apex; stigma contracted. Peric.
Follicles two, almo cylindrical, either distinct or cohering,
pointed, erect. Seeds numerous, inserted into the margins
of each follicle, oblong, impregnated downward, crowned at
the lower extremity with silky hairs, directed towards the
base of the feed-veil.

Eff. Ch. Corolla oblique, falver-shaped; mouth crowned
with ten divided scales. Stamens prominent. Follicles two,
erect. Seeds impregnated downward, hairy at the lower
extremity.

A genus of upright shrubs, or small trees, natives of the
East Indies, Ceylon, the Malay archipelago, or the tropical
part of New Holland. Their leaves are opposite. Flowers
white, corymbose, nearly terminal. Albumen none. Embryo
white, turning rose-coloured by immersion in warm water;
coyledons involute longitudinally. Brown.

Ait. n. 1. (Nerium antidysterenicum; Linn. Sp. Pl. 306,
excluding Rheed’s synonimy. Willd. Sp. Pl. v. i. 1236.
N. n. 157; Linn. Zeyl. 45. N. indicum, filigos angulatis,
erectis, longis, geminis; Burm. Zeyl. 157. t. 77.4—Leaves
obovate-oblong, short-pointed, smooth. Corymbis mottly
terminal. Tube of the corolla fix times as long as the
calyx. Follicles distinct.—Native of Ceylon. A hand-
some erect shrub, with numerous branches. Leaves on
short flakts, spreading, two inches, or two and a half,
inch. Tube as well as limb of the flowers each an inch in
length. Follicles thrice as long, a little swelling upwards;

v. 4. 309. Willd. Sp. Pl. v. i. 1236. Apocynum arbo-
reilens, neriis flore minus; Burm. Zeyl. 23. t. 12. f. 2.)—
Leaves oblong-lanceolate, blunt-pointed, smooth. Corymb
terminal. Tube of the corolla four or five times as long as
the calyx. Follicles distinct.—Native of Ceylon. Our
specimen was given to Linnaeus by Burmann. The
branches are long and straight, round, purplish. Leaves smaller
than the last, about an inch and a half long, with more or less
of a linear blunt point. Flowers like the preceding, but,
according to Mr. Brown, the tube is shorter in proportion.

elliptic-
elliptic-lanceolate, or ovate, pointed, smooth. Branches and corymbbs divericated. Tube of the corolla twice the length of the calyx. Follicles distinct."—Found by Koenig and Roxburgh in the East Indies. We received from Dr. Roxburgh in 1789, by the name of Nerium antisnyderiicum, specimens which answer to the above characters, except that the tube is not at all longer than the calyx; the limb moreover appears purplish, and is clothed on both sides with fine pubescence. This plant must be known to Mr. Brown, and perhaps is one of the undescribed species of which he makes mention.


This author speaks of some other species, of which he has not yet published either characters or names, and which are not known to us. *Nelum-Pala*, Rhede Hort. Mal. v. 9. 5. t. 3 and 4, is presumed to belong to the present genus.

WRIGHTSBOROUGH, in Geography, a settlement in the state of Georgia, on a branch of the Savannah; 30 miles W. of Augusta.

WRING-HOUSE, in Rural Economy, a name sometimes applied to the place for making cider in, in the southern districts.

WRINGLE-TAIL, a name given by the people of several parts of England to the *curvicauda*, a species of bee-fly, very much resembling the bee in shape, but having only two wings and no sting. It is very troublesome to horseters, but does not suck their blood, but only lays its eggs in their skins: it is called in other countries the *cobane* and the *harebell-fly*.

WRINGTON, in Geography, a market-town in the hundred of Brent-with-Wrington, in the county of Somer-set, England, is situated to the S.W. of the Mendip hills, at the distance of 6 miles N.N.E. from Axbridge, and 139 miles W. from London. The streets are irregularly built, and most of the houses are thatched. A weekly market, by a very ancient grant, is held on Tuesday; and here is an annual fair. In the market-place are the ruins of a croft. The church, a spacious edifice, 120 feet in length and 52 in width, consists of a nave, chancel, side aisles, and a porch. The tower, at the west end, is 140 feet high to the top of the battlements, which are adorned with four turrets, one at each corner, and sixteen elegant pinnacles fifteen feet in height. The church contains several ancient and modern monuments. One is of peculiar beauty: it is built of white and Sienna marble, and was erected in memory of Dr. Henry Waterland, prebendary of Brivel, and above fifty years minister of this parish, where he constantly resided: he died March 27, 1779. In the town is a free-school for five boys and as many girls. In the return of the year 1811, the population of the parish is enumerated as 1129, the number of houses as 183. Wrington is distinguished by being the birth-place of the celebrated philosopher, John Locke; he was born 1632, in an old thatched house, still standing on the north side of the church-yard: he died October 28, 1704. See Locke, John.—Collinson's History of Somersetshire, vol. i. 1791.

WRIST, Carpus, in Anatomy. See Extremities.

WRIST, Fracture, Ligaments, and Lussation of. See the respective articles.

WRIST, in the Manege. The bridge wrist is that of the cavalier's left-hand. A horsemans wrist and his elbow should be equally raised, and the wrist should be two or three fingers above the pummel of the saddle. To ride a horset from hand to hand, i.e. to change hands upon one tread, you need only to turn your wrist to that side you would have the horset to turn to, without advancing your hand. But if your horset stops, you must make use of both your legs. See Hand and Legs.

WRIT, formed from the Saxon *writan*, to write, Breve, in Law, a precept of the king in writing, under seal, influing out of some court to the sherrif or other person, whereby any thing is commanded to be done, touching a suit or action, or giving commiffion to have it done: as, the fummoning of a defendant, taking a diffref, redressing a diffein, or the like. Or, according to Fitzherbert, a writ is a formal letter of the king in parchment, sealed with a seal, and directed to some judge, officer, or minifier, &c. at the suit or plaint of a subjef, requiring to have a thing done, for the cause briefly expressed, which is to be discussed in the proper court according to law. See Breve, Brief, and Precipe.

Wits are variously divided, and in various respects. Some, with regard to their order, or manner of granting, are termed original, and others judicial.

Writs, Original, are those sent out of the high court of chancery, to summon the defendant in a personal or tenant in a real action; either before the suit begins, or to begin the suit by it. See Original.

Royal writs are held to be demandable of common right, on paying the usual fees; for any delay in the granting of them, or setting an unusual or exorbitant price upon them, would be a breach of Magna Charta, cap. 29. "Nulli vendemus, nulli negabimus, aut differamus juisitiam vel rectum."

Original writs are either optional or peremptory, or, in the language of our law, they are either a *precipe* or a *fe dicitur facerum*.

Writs, Judicial, are those sent by order of the court where the cause depends, upon emergent occasions, after the suit begins.

Judicial writs are distinguished from original, in that their tete bears the name of the chief-justice of that court whence they come; whereas the original lay, *tete metiyo*, in the name or relating to the king.

The original writ is always made returnable at the distance of at least fifteen days from the date or tete, and upon some day in one of the four terms; and all judicial writs, being granted on the sherrif's return, must respectively bear date the same day on which the writ immediately preceding was returnable. See Process.

Judicial writs, if erroneous, may be amended: whereas original writs are not amendable, if the error be by default of the party who gave instruction; yet a new original may be taken out, where it is not amendable.

Writs are also distinguished, according to the nature of the action, into real and personal.

Real, are either touching the possession, called *writs of entry*; or the property, called *writs of right*. See Recto.

Personal, are those relating to goods, chattels, or personal injuries.

To which may be added *mixt* writs, for the recovery both of the thing and damages.

Some writs, again, are at the suit of the party; some, of office; some, ordinary; some, of privilege. A writ of privilege is that which a privileged person brings to the court for his exemption, by reason of some privilege which he enjoys.

But the most common writs in daily use are, in debt, de-
continuë, trespassis, action upon the cafe, account, and covenant, &c. which, as well as others, must be rightly directed, or they will be naught.

Writs may be renewed every term, until a defendant is arraigned; but in the court of king’s bench, if the latitudo be not renewed in five terms, a new writ is to be taken out, and the plaintiff is not allowed to renew the old one.

The sheriffs’ bailiffs cannot execute a writ directed to the sheriff, without his warrant: and if several percons are included in a writ (for four defendants may be in one writ), there must be several warrants from the sheriff to execute the same. All writs are to be returned and filed in due time, to avoid post-terminus.

Attachment lies against sheriffs, &c. for not executing a writ, or for doing it oppressively by force, extorting money on it, or not doing it effectually, by reason of any corrupt practice.

Writ of Appraisement, a writ issued out of court for the valuation of goods seized as forfeited to the crown; or goods taken as prize of war, or found wrecked, flotam, or jetam.

Several feizes are by several percons not amounting to 100l. may be included in one writ. (Bunbury, p. 63.) And a new writ was ordered where the first appraisement was too high. (Ibid. 49. 185.) They are also required to specify the goods particularly, p. 89.

Writ of Affidavit. See Affidavit.

Writs of Affiance, are writs issued out of the exchequer, to enable officers to enter ships, houses, warehouses, and other places, to search for smuggled or prohibited goods. They are directed to be granted by 13 & 14 Car. II. c. ii. and are issued on oath, that there is strong presumption to believe goods of those kinds are harboured; but if they are executed in the night, the officers must be accompanied by a peace-officer.

Writ of Capias. See Capias.

Writ of Delivery, a writ directing the delivery of goods out of the king’s possession, either by verdict or by consent. They cannot be issued till the information is in court (Bunbury, p. 27.) and they are discretionery in court. (Ibid. p. 106.) A writ was granted out of the exchequer for watchs, because the springs and steel-work were liable to rust (p. 74.); but it was refused for tobacco-flasks, because they were directed to be burnt. (P. 106.) A writ was also refused in Ladd’s and in Thomfett’s cafe, in the same court, for coins; the former reported, the latter not reported.

Writ of Distraint. See Distraint.


Writ of Entry. See Entry.

Writ of Inquiry of Damages, a judicial writ that issues out to the sheriff upon a judgment by default, in the action of the cafe, covenant, trespass, trover, &c. commanding him to summon a jury to enquire what damages the plaintiff hath sustained, occasionem pennisium; and when this is returned with the inquisition, the rule for judgment is given upon it; and if nothing be said to the contrary, judgment is thereupon entered. 2 Litt. Ab. 721.

Writ of Mainprise. See Mainprise.

Writ of Nisi prius. See Nisi prius.

Writ of Rebellion. See Commission of Rebellion.

Writ of Right. See Recto.

Writs Vicountiel. See Vicountiel.

Writ, Action of a. See Action.

Writ, Appeal by. See Appeal.

Writ, Attachment by. See Attachment.

Writ, Continuance of a. See Continuance.

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WRITER of the Tallies, an officer of the exchequer, being clerk to the auditor of the receipt, who writes upon the tallies the whole letters of the tellers’ bills. See Tally and Exchequer.

WRITING, Scriptura, the art or act of signifying and conveying our ideas to others, by letters or characters visible to the eye.

Or, writing may be defined to be the act of exhibiting to the light the conceptions of the mind, by means of marks or characters significant of the sounds of language, which enable us to transfer ideas from the eye to the ear, and vice versa.

Written characters are of two sorts: they are either signs for things, or signs for words. Of the former sort, are the pictures, hieroglyphics, and symbols, employed by the ancient nations; of the latter sort, are the alphabetical characters now employed by all Europeans. Pictures were, undoubtedly, the first essay towards writing; accordingly, we find in fact, that this was the only sort of writing known in the kingdom of Mexico, when America was first discovered. By historical pictures, the Mexicans are said to have transmitted the memory of the most important transactions of their empire. (See Warburton’s Divine Legat. of Moses, vol. ii. part i. p. 67, &c. vol. iii. p. 73. Robertson’s Hill. vol. iii. p. 203, &c. &c. and Appendix, note 16. 26. 440. edit. 8vo.) But as pictures could do no more than delineate external events, without exhibiting their connections, describing such qualities as were not visible to the eye, or conveying any idea of the dispositions or words of men, there arose in process of time, for supplying this defect, the invention of hieroglyphical characters; which may be considered as the second stage of the art of writing.

Hieroglyphics (which see) consist in certain symbols, which are made to stand for invisible objects, on account of an analogy or resemblance which such symbols were supposed to bear to the objects. Among the Mexicans, they found some traces of hieroglyphical characters, intermixed with their historical pictures. But Egypt was the country where this sort of writing was most studied, and brought into a regular art. However, this sort of writing could be no other than enigmatical and confused, in the highest degree; and must have been a very imperfect vehicle of knowledge of any kind.

As writing advanced from pictures of visible objects to hieroglyphics, or symbols of things invisible; from these latter it advanced, among some nations, to simple arbitrary marks which float for objects, though without any resemblance or analogy to the objects signified. Of this nature was the method of writing practised among the Peruvians; who made use of small cords, of different colours, and by knots upon these, of various sorts, and differently arranged, contrived signs for giving information, and communicating their thoughts to one another. Of this nature, also, are the written characters which are used to this day in China. The Chineese have no alphabet of letters, or simple marks, which compose their words; but every single character which they use in writing is significant of an idea: it is a mark which stands for some one thing or object, and consequently the number of these characters must be immense. This Chinese writing, (which see,) probably began, like the Egyptian, with pictures and hieroglyphical figures, which figures being, in their progress, abbreviated in form, for the sake of more easily writing them, and greatly enlarged in number, passed at length into those marks or characters which they now use, and which have spread themselves through several nations of the East. For it is said, that the Japaneze, the Touquiniche, and the Coroeans, who speak
speak different languages from one another, and from the inhabitants of China, use the same written characters with them, and thus intelligibly correspond with each other in writing, though ignorant of the language spoken in their several countries. Our European arithmetical figures are significant marks, precisely of the same nature with the Chinese characters. Thus far nothing has appeared which resembles our letters, or which can be called writing, in the sense now given to that term. What we have hitherto seen were all direct signs for things, and made no use of the medium of sound or words; either signs by representation, as the Mexican pictures, or signs by analogy, as the Egyptian hieroglyphics; or signs by institution, as the Peruvian knots, the Chinese characters, and the Arabian cyphers. At length, in different nations, men became sensible of the imperfection, the ambiguity, and the tediousness of each of these methods of communication with one another, and began to consider the advantage resulting from employing signs, which should stand not directly for things, but for the words which they used in speech for naming these things; and they also considered, that though the number of words in every language be very great, yet the number of articulate sounds, used in composing these words, is comparatively small. Hence they were led to invent signs, not for each word by itself, but for each of those simple sounds that are employed in forming words; and they observed, that by joining together a few of those signs, it would be practicable to express, in writing, the whole combination of sounds which our words require.

The first step in this new progress was the invention of an alphabet of syllables, which probably preceded the invention of an alphabet of letters, among some of the ancient nations; and which is said to have been retained, to this day, in Ethiopia, and some countries of India. By fixing upon a particular mark or character for every syllable in the language, the number of characters, necessary to be used in writing, was reduced within a much smaller compass than the number of words in the language. Still, however, the number of characters was great; and men have continued to render both reading and writing very laborious arts. At last some happy genius arose; and tracing the sounds made by the human voice to their most simple elements, reduced them to a very few vowels and consonants; and, by affixing to each of these the signs which we now call letters, taught men how, by their combinations, to put into writing all the different words, or combinations of sound, which they employed in speech. By being reduced to this simplicity, the art of writing was brought to its highest state of perfection, and in this state, we now enjoy it in all the countries of Europe.

To whom we are indebted for this admirable and useful discovery does not appear. There seems reason to conclude, from the books which Moses has written, that, among the Jews, and probably among the Egyptians, letters had been invented prior to his age. The universal tradition among the ancients is, that they were first imported into Greece by Cadmus the Phoenician, who, according to the common system of chronology, was contemporary with Joshua; but according to Sir Isaac Newton’s system, contemporary with King David. As the Phoenicians are not known to have been the inventors of any art or science, though, by means of their extensive commerce, they propagated the discoveries made by other nations, the most probable and natural account of the origin of alphabetical characters is, that they took rise in Egypt, the first civilized kingdom of which we have any authentic accounts, and the great source of art and policy among the ancients. In that country, the favourite study of hieroglyphical characters had directed much attention to the art of writing. Their hieroglyphics are known to have been intermixed with abbreviated symbols, and arbitrary marks; whence, at last, they caught the idea of contriving marks, not for things merely, but for sounds. Accordingly, Plato (in Phaedo) expressly attributes the invention of letters to Theuth or Thoth, the Egyptian, who is supposed to have been the Hermes, or Mercury, of the Greeks. Cadmus himself, though he passed from Phoenicia to Greece, as several of the ancients have asserted, was originally of Thebes in Egypt. Most probably Moses carried with him the Egyptian letters into the land of Canaan; and there, being adopted by the Phcenicians who inhabited that part of the country, they were transmitted into Greece.

It is curious to observe, that the letters which we use at this day, can be traced back to the alphabet of Cadmus. The Roman alphabet, which obtains with us and most of the European nations, is plainly formed on the Greek, with a few variations. And all learned men observe, that the Greek characters, especially according to the manner in which they are formed in the oldest inscriptions, have a remarkable conformity with the Hebrew or Samaritan characters, which, it is agreed, are the same with the Phcenicians, or the alphabet of Cadmus. If the Greek characters are inverted from left to right, according to the Phcenician and Hebrew manner of writing, they will appear to be nearly the same. Before the conformity of figure, the names or denominations of the letters, alpha, beta, gamma, &c. and the order in which they are arranged, in all the several alphabets, Phcenician, Hebrew, Greek, and Roman, agree so much, as to amount to a demonstration that they were all originally derived from the same source. The letters were, at first, written from the right-hand to the left; and this manner of writing obtained among the Assyrians, Phcenicians, Arabsians, and Hebrews; and from some very old inscriptions, it appears to have obtained also among the Greeks. Afterwards the Greeks adopted the method of writing their lines alternately from the right to the left, and from the left to the right, called boustrophedon. At length, however, the motion from the left-hand to the right being found more natural and commodious, the practice of writing, in this direction, prevailed throughout all the countries of Europe. See more on this subject under Alphabet, Characters, and Letters.

Writing was long a kind of engraving. Pillars, and tables of stone, were first employed, and afterwards, plates of the softer metals, such as lead; but as writing became more common, lighter and more portable substances were employed. The leaves, and the bark of certain trees, were used in some countries; and in others, tablets of wood, covered with a thin coat of soft wax, on which the impression was made with a stylus of iron. See Book, Bark, and Style.

In later times, the skins of animals, properly prepared and polished into parchment, were the most common materials: our present method of writing on paper is an invention of no greater antiquity than the fourteenth century.

The advantages of writing above Speech (which see) are, that writing is both a more extensive and a more permanent method of communication: nevertheless, spoken language has a great superiority over written language, in point of energy or force. See Warburton, ubi supra. Blair’s Lectures on Rhetoric, &c. vol. i. lec. 7.
An ingenious and learned writer has lately discussed the subject of this article in a very elaborate manner. He observes, that there is a difference, deferring particular attention in the inquiry, concerning the origin and progress of writing, between the imitative characters and symbolic or arbitrary marks. The former derive their origin from that imitative faculty, which is so conspicuous in the human species; the latter are founded in necessity or convenience, and become significant by compact; the one comprehends symbols and marks for sounds, significant of ideas; and the other has an immediate reference to sensible objects which present themselves to sight, and are applicable to hieroglyphical representations. Accordingly all representations, marks, or characters, which were ever used by any nation or people, must have been either imitative or symbolic.

This writer controverts the opinion of M. Fourmont, bishop Warburton, and M. Gebelin, who have endeavored to shew, that alphabets were originally formed of hieroglyphical characters; alleging that the letters of an alphabet were essentially different from the characteristic marks deduced from hieroglyphics, which are marks for things and ideas, like the ancient and modern characters of the Chinoic; whereas the former are only marks for sounds; and that, though there be a sufficient resemblance between the Mexican picture-writing, the Egyptian hieroglyphics, and the Chinese characters, yet these are foreign to alphabetic letters, and, in reality, do not bear the leaf relation to them. The hieroglyphic characters of the Chinoic are, it is said, in their nature imitative, and do not combine into words, like arbitrary marks for sounds or letters, which are very few, and of a symbolic nature.

Letters, it is maintained, do not derive their powers from their forms, but originally their forms entirely depended on the fancy or will of those who made them.

Many learned men have supposed, that the alphabet was of divine origin; and several writers have alleged, that letters were first communicated to Moses by God himself; whilst others have contended, that the Decalogue was the first alphabetic writing. But if this art had been a new discovery in the time of Moses, he would probably have commemorated it; nor is there any reason to suppose, that God was the immediate revealer of the art, for Moses could never have omitted to have recorded the history of so important a circumstance, as the memory of it would have been one of the strongest barriers against idolatry.

It appears, however, that the art of writing is of great antiquity, and that the ancients, who ascribed the invention of it to the gods, had very imperfect ideas of its true origin. When it is considered that letters must have been the produce of a certain degree of civilization among mankind, the inquirers into their original have been naturally led to seek it in the history of those nations that appear to have been first civilized. Accordingly, many authors have decided in favour of the Egyptians. See Letters.

Others have vindicated the claim of the Phenicians to the invention of letters; urging the testimony of Sanonathi, the most ancient and also the most celebrated Phenician historian, corroborated by Pliny, Curtius, Lucan, Eusebius, &c. as well as their very early and high degree of civilization. The Chaldeans have also had several learned advocates, who have attributed the invention of letters to the patriarch Abraham; and Sir Isaac Newton, in particular, admits, that letters were known in the Abrahamic line for some centuries before Moses.

It is needless to mention the claims of the Tuscan, Indians, and Arabians. Mr. Alder, ubi infra, declares in favour of the Phenicians; and observes, that as the Chaldeans, Syrians, Phenicians, and Egyptians, all bordered upon each other, and as the Phenicians were the greatest as well as the most ancient commercial nation, it is very probable that they communicated letters to the Egyptians; the ports of Tyre and Sidon, and those of the Egyptians, being not far distant from each other. This author adds, that before the time when Mizraim went into Egypt, in the year before Christ 2188, and 160 years after the flood, Tant, his son, had invented letters in Phenicia; and if this invention took place ten years before the migration of his father into Egypt, as Mr. Jackson supposes, we can trace letters as far back as the year 2178 before Christ, and 150 after the deluge recorded by Moses: and beyond this period, the written annals of mankind, which have been hitherto transmitted to us, will not enable us to trace the knowledge of them, though this want of materials is no proof that letters were not known until a century and a half after the Deluge.

An opinion seems to be gaining credit among the learned, that arts and letters took their rise in the northern parts of Asia, and that they were cultivated in those parts long before they were practised in Phenicia or Egypt. Some travelled southwards, others laid behind; and those who afterwards emigrated from the East were generally called Sythians, and sometimes Huns, who overspread the northern parts of Europe. Many settlements were made in Germany long before the Christian era.

It has been asserted by many writers, that all alphabets are derived from one; but Mr. Alder maintains, that there are various alphabets used in different parts of Asia, which differ from the Phenician, ancient Hebrew, or Samaritan, in name, number, figure, order, and power. In several of these alphabets, there are marks for sounds peculiar to the language of the East, which are not necessary to be employed in the notation of the languages of Europe.

The following alphabets, says this learned writer, seem to be immediately derived from the Phenician; viz. the ancient Hebrew, or Samaritan; the Chaldæan, the Babylonian, or that of the colony of Phenicians or Carmanites, who are said to have fled from Joshua, and to have settled themselves, in the most early ages, in that part of Spain now called Andalusia and Grenada; the Punic, Carthaginian, or Sicilian; the Pelasgian Greek, and its derivatives, which are written in the Eastern manner, from right to left; and the Ionic Greek, written from left to right. This last-mentioned branch from the Pelasgic stock is the source from whence not only most of the alphabets of Europe are derived, but also of many others which have been adopted in different parts of Asia and Africa. From the Ionic Greek are derived the Arcadian, the Latin or Roman, the ancient Gaulish, the ancient Spanish, the ancient Gothic, the Coptic, the Russian, the Illyrian or Scyphilian, the Bulgarian, and the Armenian; the Runic is immediately derived from the Gothic.

The alphabets derived from the Roman are, the Lombardic, the Vulgar Gothic, the Saxon, the Gallican, the Franco-Gallic or Merovingian, the German, the Caroling, the Capetian, and the Modern Gothic. The first relates to the MSS. of Italy; the second, to those of Spain; the third, to the MSS. of Great Britain; the fourth and fifth,
to those of France; the sixth, to Germany; the seventh, eighth, and ninth, to all the countries of Europe where Latin is read. The six former alphabets are before the age of Charlemagne; the three latter follow it. The characters of these are more distinguished by their names than by their forms, which indicate that they are all of Roman extraction. The Lombardic, introduced into Italy by the Lombards in 569, was used by the popes in their bulls, and sometimes called Roman in the eleventh century; it ceased in the thirteenth century. The Visigothic, or Spanish Gothic, was introduced into Spain by the Goths or Visigoths; it was abolished in a provincial synod, held at Leon in 906, when the Latin letters were established for all public instruments; though these characters were occasionally used in private transactions for upwards of three centuries afterwards. Saxon writing admits of various distinctions, viz. the Anglo-Saxon, Britanni-Saxon, and Dano-Saxon. The Gauls, on being subdued by the Romans, adopted their mode of writing; and by additions of their own, gave rise to the Gallican or Roman Gallic. The Franks, a people of Germany, having conquered part of Gaul, introduced their characters called Franco-Gallic, or Merovingian, because this kind of writing was practised under the kings of the Merovingian race. It took place about the close of the sixth century, and prevailed till the beginning of the ninth. The Carolingian was derived from the improvement of Charlemagne; this declined in the twelfth century, and totally disappeared in the thirteenth, when it was succeeded in Germany by the Modern Gothic. The Carolingian writing was restored by Hugh Capet about the year 987, and called Capetian: it was much practised till about the middle of the twelfth century; but in the thirteenth it degenerated into the Modern Gothic. The Capetian writing was used in England and in Germany, as well as France, during the above-mentioned period. The Modern Gothic, which spread itself over Europe in the twelfth and thirteenth centuries, is improperly so called; because it does not derive its origin from the writing anciently used by the Goths and Visigoths in Italy and Spain, but it is the most barbarous kind of writing; it took its rise in the decline of the arts among the lazy schoolmen, who had the worst taste; it is nothing more than the Latin writing degenerated. It began in the twelfth century, and was generally used (especially by monks and schoolmen) in all parts of Europe, till the restoration of the arts in the fifteenth century, and longer in Germany and the northern nations. Our statute-books are still printed in Gothic letters.

The learned are not agreed with respect to the origin of what is called national writing. Some will have it, that the Roman manner prevailed throughout the West, until the irruption of the barbarous nations of the North, in the fifth and sixth centuries: the Goths, they say, first introduced their mode of writing into Italy, instead of the Roman manner; the Visigoths did the like in Spain; the Franks in Gaul; the Saxons in England; and the Lombards in Italy.

According to others, the Romans were in possession of various forms of writing; but it is supposed, that the barbarous nations introduced some of their own letters in the writings composed of capitals and small letters; that the running-hand, peculiar to each nation, was used in grants and contracts, and found admittance likewise in manuscripts after the middle of the seventh century.

Mr. Alle, however, is of opinion, that the different modes of writing in Italy, Spain, France, England, and Germany, were derived from the Roman alone.

While Rome continued the centre of all the provinces of the empire, her manner of writing generally prevailed in each; but the empire being dismembered, and all the western provinces disunited, a change was produced; the conquerors disfigured the Roman writing, and by their false taste and ignorance, distinguished their writing from that of their neighbours: the genius and disposition of the different people having no small share in producing this diversity.

This notion greatly affords in discovering the age of manuscripts; for if a writing is Merovingian, it cannot be subsequent to the ninth, nor prior to the fifth century; if another is Lombardic, it must be posterior to the middle of the sixth, and anterior to the thirteenth; if Saxon, it cannot be earlier than the seventh, nor later than about the middle of the twelfth.

With regard to the forms of letters, many authors are of opinion that they are derived from the positions of the organs of speech in their pronunciation. Accordingly, M. Van Helmont hath taken great pains to prove, that the Chaldaic characters are the genuine alphabet of nature, because, he says, no letter can be rightly founded, without disposing the organs of speech into an uniform position with the figure of each letter.

Mr. Alle published a work, in which he endeavours to shew that all elementary characters or letters derive their form from the line and the circle. Mr. Gebelin deduces them from hieroglyphic representations, and he hath given several delineations of human figures, trees, &c. in confirmation of his hypotheses. Mr. Alle observes, that as letters are only marks for sounds, their forms entirely depended upon the taste, fancy, will, or caprice, of those who first formed them. In this point of view, they may be considered as arbitrary marks, or secret ciphers, which, by being made known and adopted, would become of general use, wherever they were received by agreement. For the number and forms of the letters of various alphabets, illustrated by figures, we must refer to Mr. Alle's account, ubi infra.

After the most diligent inquiry, it doth not appear, says Mr. Alle, that the Britons had the use of letters before their intercourse with the Romans; and though, from the coming of Julius Cæsar till the time when the Romans left the island in the year 427, the Roman letters were familiar to the eyes of the inhabitants, he is of opinion, that writing was very little practised by the Britons till after the coming of St. Augustine, about the year 596.

The writing which prevailed in England from this time to the middle of the eleventh century, is generally termed Saxon, and may be divided into five kinds; viz. the Roman Saxon, which is very similar to the Roman, and prevailed in England from the coming of St. Augustine till the eighth century; the fet Saxon, which took place toward the middle of the eighth century, continued till about the middle of the ninth, and was not entirely diffused till the beginning of the tenth century; the running-hand Saxon, which came into use towards the latter end of the ninth century, when learning was diffused in England under the auspices of King Alfred, in whose reign many books were written in this island, in a more expeditious manner than formerly; the mixed Saxon, occurring in the ninth, tenth, and in the beginning of the eleventh centuries, in many MSS., which were written in England in characters partly Roman, partly Lombardic, and partly Saxon; and the
elegant Saxon, which took place in England early in the
tenth century, lafted till the Norman Conquest, but was not
tirely difuted till the middle of the twelfth, and is more
beautiful than the writing in France, Italy, and Germany,
during the fame period.

The writing introduced into England by William I. is
usually called Norman, and is compofed of letters nearly
Lombardic, which were generally used in grants, charters,
public instruments, and law proceedings, with very little
variation, from the Norman Conquest till the reign of King
Edward III.

About the reign of King Richard II., variations took place
in writing records and law proceedings; the charters
from the reign of King Richard II. to that of King Henry VIII.
were compofed partly of characters called fet chancery and
common chancery, and some of the letters called court-
hand; which three different species of writing are derived
partly from the Norman and partly from the modern
Gothic. The modern Gothic began to take place in Eng-
lund in the twelfth century; the old English about the
middle of the fourteenth century; and fet chancery and
common chancery in the decline of the fame century, and
are still used in the enrollments of letters patent, charters,
&c. and in exemplifications of recoveries: the court-hand
was contrived by the English lawyers, and took its rise
about the middle of the sixteenth century, and continued
till the beginning of the late reign, when it was abolished
by law. The court-hand characters were nothing more than
the Norman characters very much corrupted and deformed.

In the sixteenth century, the English lawyers engrossed
their conveyances and legal instruments in characters called
secretary, which are still in use.

The French call their writing by the names of the dif-
rerent races of their kings, in whom they are written:
these were, the Merovingian, the Carlingian, the Capetian,
the Valesian, and the Bourbonian.

The writing called Merovingian began in France soon
after the time of Meroveus, son of Pharamond; who was
made king A.D. 460: this race ends with Childeric, who
died in 752. The Caroline race properly began with Pepin,
who was made king of France upon the death of Childeric.
This prince was succeeded by Charlemagne, A.D. 814,
whose line in France ended with Lewis V. A.D. 987.
The Capetian race began with Hugh Capet, who succeeded
Lewis V., and ended with Charles IV. A.D. 1327.
The Valetian race began with Philip IV. the fucceffer of
Charles IV., and ended with Henry III. the last of this
line, who was slain in 1389. The Bourbonian line began
with Henry IV. A.D. 1589, whose defendants now fill
the throne of France.

The MSS. written in the northern parts of Scotland and
in Ireland are in characters similar to the Saxon. The
learned and ingenious colonel Vallancey thinks, indeed, that
the Iberians, who migrated from the borders of the Euxine
and Caflpien seas, and settled in Spain, learned letters and
arts from the Phoenicians: that a colony of the ancient
Spaniards, by the name of Scots or Scythians, settled in
Ireland about a thoufand, or perhaps fix hundred years
before Chrift, and that they brought elementary characters
with them into Ireland. He observes, that the Irish alphabet
differs from that of all other nations, in name, order,
number, and power, and fuppofes, that they might have
received their alphabet from the Cteuthians, who also
fettled a colony in Ireland about six hundred years before
Chriff; and adds, that this opinion is the more to be cre-
dited, as the Irish language appears to have a radical identity
with the Punic.

WRITING.

In order to discover what real pretentions the Irish have
to the early ufe of letters, for which they eagerly contend,
Mr. Aftle has examined their ftonem muments, their coins,
and their MSS., and appealed to the historians of that
country. The letters upon the moft ancient of their mo-
uments are apparently of Roman and Roman-British ori-
ginal; and none of these inftribed monuments are fo ancient
as to prove that the Irish were poffeffed of letters before the
Romans had intercourse with the Britons; though they
prove that they had letters before the arrival of St. Patrick
in that kingdom, which, Mr. Whitaker, with great
probability of truth, fays, were wafted over from the Cal-
donian, who used the Roman letters. Sir James Ware
fays, that the Irish alphabet was borrowed from theBritifh,
and that the Saxon characters were nearly the fame as the
Irish; and adds, that Mr. Camden inclined to this opinion.

Moreover, there are no Irish coins, inftribed with letters,
till long after the twelfth century: except coins fluck by
fome of our Saxon kings, who made incursions into that
country, and fluck money there in the Saxon manner.

The oldest Irish MS. which has been discovered is the
Pfalter of Canhel, written in the latter end of the tenth
century.

The testimony of approved historians is likewise unfa-
vourable to the ancient literature of Ireland. Mr. Innis,
in his Effay on the Antiquities of Scotland and Ireland,
and Mr. James Macpherson, in the third edition of his In-
troduction to the History of Great Britain and Ireland,
maintain, that Ireland was ftrongly peopled from Britain;
and that the manners of the old Irish were incompatible with
the knowledge of letters.

It seems probable, that the interior parts of Europe were
immediately peopled from the northern parts of Asia, and
the maritime parts from Phoenicia, and the southern and
western parts of that quarter of the globe. If this be the
case, it is not purfuing that fome Eastern cuftoms prevailed
in Great Britain and Ireland, and that many Celtic words
are still preferred both in the Irish and in the Welsh
languages.

The Norman characters, it is observed, were generally
used in England from the coming of William I., and the
Saxon characters were entirely diftributed in the very begin-
ing of the twelfth century; but the Irish and Scots preferred
the ancient forms of their characters till the end of the six-
teenth century.

The Gallic or Erfe language, used in the Highlands of
Scotland, and the Iberno-Gallic, are nearly the fame, and
their letters are similar to each other, as Mr. Aftle has
fewn by various specimens. The curious will find much
information on the subject of this article in Aftle's Origin
and Progrefs of Writing, 4to. 1751.

J. Ravena has a treafure, intitled "Des Inscriptions en
Faux," in which he fhefs how to revive and reftore old
writings almost effaced, by means of galls ground in white
wine and diftilled, and thus rubbed over the writings.

To write without blacking the fingers: prepare the paper
with a fine powder, made of three parts of calcined cop-
ners, two of galls, and one of gum arabic; thofe being
freh mixed, rub them with a hare's foot into the pores of
the paper, and then write with fair water, and the black
letters will immediately appear.

To make new writing appear old, moisten it with oil of
tartar per deliquum, more or less diluted with water, as you
defire the ink to appear more or less decayed.

We may write without ink or its materials: for this pur-
pofe, take a fine powder of calcined harthorn, of clean
tobacco-pipes, or rather of mutton-bones burnt to a perfect
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Vol. XXXVIII.
whiteness, and rub it upon the paper, and then write with a silver bodkin, or the like. Boyle's Works, 2nd vol. i. p. 114, 115. See Ink.

The discharging of ink out of parchement, paper, &c. is commonly done by aqua fortis diluted sufficiently with water, that it may not destroy the paper. The like may be done with oil, or spirit of vitriol diluted. The juice of lemons, or strong vinegar, will take ink out of linen more safely, as the mineral acids are apt to destroy the linen, unless great care be used in diluting them.

We may write on iron with corrosive sublimate wetted with common water: for this purpose, the parts of metal we would preserve untouched should be covered with wax, and that taken off in the proper places to make way for the corroding sublimate. Boyle, ib. p. 528.

The like may be practiced by means of aqua fortis.

Mr. Boyle mentions a method he had of copying a whole page of writing at once. But we do not find his description of it anywhere. Ib. p. 136.

A machine has been lately invented and constructed by Messrs. Watt and Co. of Birmingham; by means of which letters and other writings may be copied. For an account of the structure and use of this machine, we must refer to the directions for copying with it, furnished by the inventors; observing, however, that the date, at which a writing will yield a copy, is extremely uncertain, from the weather, as it is more or less drying, and from the state of the ink. In general the purpose will be answered to the end of twenty-four hours, and sometimes of three or four days; but it is most advisable to copy letters as soon after they are written as may prove convenient. See Copying.

Mr. Boyle informs us of a method of imitating writing on copper-plates. The copy to be engraved is to be written with a peculiar kind of ink, and the copper-plate being moderately warmed is rubbed over with a white varnish, and suffered to cool; then the paper being gently moistened, that it may readily communicate its ink, the writing is applied to the prepared surface of the plate, and passed through a rolling-pref; by which means, the ink adhering to the varnish leaves the letters very conspicuous. And hence it is easy with a needle to trace the strokes through the varnish upon the plate, which being afterwards cleaned, the letters are finished with the graver, and the work printed off in a rolling-pref, as common cuts.

Mr. Boyle does not mention what the varnish or ink, used by the artificer from whom he received this method, was; but he tells us, that he himself used the purer fort of virgin wax for a varnish; and for his ink he took fine Frankfort black, carefully ground with water, till it obtained the consistence of common ink; but no gum was added, lest it should hinder the ink from coming off. He also observes, that written characters may be taken off without the help of a pre, by laying the moistened paper smooth upon the varnished copper, and rubbing it on hard with a convex piece of glass. See Sympathetic Ink.

In law, we say, deeds, conveyances, &c. are to be in writing. A will may either be in writing, or by word of mouth.

We also say, written laws, lex scripta, in opposition to common law, which is called lex non scripta. We have also written and unwritten traditions, &c.

Authentic writings of any contract, sealed and delivered, make the evidences thereof.

La Vayer has a curious dissertation on the proof of facts by comparison of hand-writings, in which he endeavours to shew this method of proof to be very suspicious and fallacious.
Harry Vane, who on the restoration of Charles II. suffered death for the part he took against Charles I. This event, on the death of lord viscount Vane in 1789, became the property of David Papillon, Esq. it is now occupied by the earl of Delawar.—Beauties of England and Wales, vol. viii. Kent, by E. W. Braley, 1807.

WROTZKo, a town of Pruffia, in the palatinate of Culm; 12 miles S.W. of Strafsburg.

WOUGHT, in Ship-Building, a term applied to any piece of timber, &c. when it is trimmed and fitted for its situation.

WROXTER, in Geography, a village of England, in the county of Salop, at the union of the Torn and the Severn, by Antoninus called "Uriconium," by Ptolemy "Viriconium," by the Welsh and Britons "Caer Vruach," and by the Saxons "Wrecenecaster." It was the chief city of the Cornavii, and founded by the Romans, when they fortified the bank of the Severn where fordable. It was encompassed by a rampart and ditch; the walls were three yards thick, and were three miles in circumference. After suffering much in the Saxon wars, it was quite ruined by the Danes, and is now but a small place. Many Roman coins and other antiquities have been found here; 5 miles S.E. of Shrewsbury, and 155 N.W. of London.

WRUNG-HEADS, a former name given to the bilge of a ship, &c. or that part near the floor-boards, which, when a ship lies aground, bears the greatest strain.

WRY-NECK, (Caput obliatum, cervix oblipta, torticollis) denotes that deformity of the human body, in which the neck is bent laterally, generally inclining at the same time somewhat forwards, so that the head is also drawn to one side and forwards, being indeed quite approximately to the shoulder. For the most part, the neck is in this case altogether irregularly formed; on the side towards which the head inclines, it seems exceedingly plump, the strong shortened muscles being bulky, and affected with considerable spasm; while, on the other hand, the opposite side, where the neck is convex, exhibits no such strong rigid muscles, or at all events so little of this appearance, that, notwithstanding its convex form, it seems obviously less flexible. When the disease has continued a long while, and attained a serious degree, its effects extend also to the head itself. On that side where the irregular action of the muscles is strongest, and where consequently the head is most drawn downwards, the half of the face is usually more or less contracted, and weaker than the opposite half, the zygomaticus major, the buccinator, the masseter, and other muscles, being considerably less prominent. This disfigurement of the countenance has a very unpleasant appearance, and plainly indicates the dislocated position into which the head is drawn. The patients are also incapable of turning their heads properly, or of directing their faces upwards; and if these functions can be executed in a very imperfect way, it is not without a good deal of effort, which in general the patients prefer avoiding. Hence they mostly choose to remain in their disfigured posture, and instead of trying to turn their heads with the muscles of the neck alone, they prefer accomplishing this object rather by turning the whole body. Hence an opportunity is given for the evil to increase in a very rapid and afflicting degree. According to the observations of Richter and Bernstein, the face is commonly turned towards the opposite side, and only now and then towards to which the head inclines. (Anfangsdr. der Wunderznykunft 4ter. Band, 2te. Auflage, f. 256. Praktischen Handbuche für Wundärzte, &c. Neue Auflage, 3ter. Theil, f. 215.) Professer Jörg of Leipic does not exactly coincide with these surgeons on this particular point; but we think that the difference is merely in terms, and not in the thing itself. Richter meaning that the face is turned towards the sound side, not that it is drawn away, and made more distant from the shoulder to which the whole neck and head incline. Professor Jörg takes a review of the action and insertions of the sternocleido-mastoideus muscle, which proceeds down the neck from the mastoid process, and splits into two portions; one of which is inserted into the external and anterior part of the clavicle, the other into the upper and outer surface of the sternum. The clavicular portion of this muscle usually need not necessarily tend to draw the head towards the clavicle, which is the fixed point, while the internal portion will pull it to the breast; but both acting together, will draw it in a diagonal line. At the same time that they have the effect of inclining the head forwards and to one side, they impart to the neck the same direction, and even slightly turn it, so that the nose is no longer situated in a straight line directly over the sternum, but is placed to one side of such a line. When, for example, says professor Jörg, the right sternocleido-mastoideus is too short, and is therefore the cause of the wry-neck, it will pull the head towards the right side, and also forwards, in such a manner that the nose is moved to the left of a line drawn upwards from the sternum, and the neck itself is at the same time slightly turned. But when this is the case, the whole face must obviously be somewhat turned towards the left side, and drawn a little way downwards and forwards. When, however, the whole head is drawn forwards, laterally (in this case to the right,) and at the same time downwards, consequentely the face forwards, laterally, (in this case to the left,) and downwards, it cannot be said that the face is moved in a different direction from that of the rest of the head. Although the face is turned in a different direction, still it is not inclined towards the opposite side; for, says professor Jörg, if this were so, the neck must be much more turned than actually happens. Hence, he thinks, that a case has really never existed, where the face and head have been inclined in different directions.

With respect to the causes of this infirmity, they are, according to several writers, very numerous, and it is not to be denied that they may be of different kinds. Yet, says Jörg, "I have never seen the complaint originate in the bones; the muscles were always the parts first concerned. According to my observations, the sternocleido-mastoideus must be looked upon as being the chief original cause of this deformity, which I have never seen unattended with the particular and manifest influence of that muscle. When also several other muscles gradually participate in the disorder, the sternocleido-mastoideus is usually the first affected. While it is more disposed to an irregular action than any other muscle of the neck, its greater strength makes it in some measure govern the rest." As children, both in the erect and horizontal postures, frequently keep their necks unevenly, and more to one side than the other, professor Jörg conceives that this will account for one sternocleido-mastoideus readily becoming shorter than its fellow; the equilibrium ceases, and a wry-neck is immediately produced. Young children often contract a habit of lying in bed constantly upon the same side, whereby the muscles of the neck become gradually habituated to an irregular kind of tension, which by degrees breaks the antagonizing power between the opposite sets of muscles. The same thing happens, when children are constantly carried with their head upon one and the same side of their nurse. But this irregularity in the muscles in question is also frequently
quently congenital, and then we need not specify any occasional causes. The evil, though it exists at the time of birth only in a trivial degree, afterwards quickly increases, and soon becomes serious. The regular equilibrium between the sternocleido-mastoidei may likewise beestroyed, when one of them is wounded, or completely cut through; when it remains preternaturally weak, in consequence of having been the seat of abscesses, and previous ulceration; or when, from any cause whatsoever, its action is rendered either too feeble or too powerful.

In one patient cured by professor Jörg, it is alleged that the inner portion of the left sternocleido-mastoideus was inserted into the middle and right side of the sternum, in the same place as the inner portion of the muscle of this name on the right; and the above author conceived, that this preternatural attachment was probably the cause of the inclination of the head to the right side.

Professor Jörg does not give much credit to the opinion, that the wry-neck is frequently brought on by a contraction of the skin of the neck and of the platysma myoides; the first of these parts being very yielding, and the second very thin and elastic. But, he thinks, that when these parts, or any other muscles of the neck, are shortened and spasmodically contracted, it is generally as a consequence of the affection of the sternocleido-mastoideus, which is the part originally disordered.

The same writer will not deny also, that the malformation of the bones may be the first cause of this infirmity. If, says he, the dorsal and lumbar vertebrae are liable to curvature, why should the cervical ones not be so, and thereby destroy the equilibrium between the muscles of the neck? Yet, he thinks, the cause of the disorder must lie much more rarely in the bones than the muscles, since he has never seen one instance of it. He admits also, that there can be no doubt that the bones sooner or later share in the effects of the disease; that they become bent to one side, and even cemented together by ankylosis.

As in every other disorder, the practitioner endeavors to find out the original cause of the complaint; and, therefore, the question arises, how can it be known whether the muscles and the integuments, or the bones, are the first cause of the deformity? The cause may be ascribed to the muscles, when there is obviously something wrong about them; when they are hard and contracted on one side, and soft and little prominent on the other; and when those which are shrunk and shortened become still harder and more painful, on putting the head in a straight position, to the doing of which they also make more or less resistance. We may be more certain of the thing, when no disease of the bones in any part of the body, and no causes of such complaint, can be detected; for when the bones are about to soften, or are already softened, the latter affection must be preceded by certain occasional causes, and accompanied with the usual symptoms. The discovery of these, according to professor Jörg, is not difficult to the practitioner, at least not impossible. The disorder, on the other hand, may be referred to the bones, when no particular defect about the muscles is apparent, when they are no where remarkably hard and contracted, and when the case is attended with symptoms and vestiges of a partial or general softening of the bones. When this is the case, the muscles are usually much less altered than when they constitute the original cause of the deformity; and the head can be more easily raised, turned, and moved about.

Another question is, what degree has the disorder already attained, and have the bones materially participated in the affection or not? Perhaps the cervical vertebrae are ankylosed? Although it may at first seem easy to answer these questions, yet it is not always so easy. The prognosis and treatment, however, are to be regulated by the decision; and we can never speak satisfactorily of the case, unless we have inquired into the whole of its progress.

When the bones are affected, that is to say, when in consequence of the wrong posture of the neck a change has taken place in their form; when they, as is most usual on the side towards which the head is inclined, are lower than on the other; or when their processes are diminished or absorbed; the practitioner can frequently feel and see that the defect lies in the texture of the bones. The depressions thus produced may sometimes be plainly seen, or, at all events, can be felt with the finger. When the head and neck are put into the right position, these depressions become still more obvious, as well as the alteration of the spinous processes. In order to derive from such examination any precise knowledge, we must indeed be well acquainted with the anatomy of the neck. Professor Jörg then gives us some directions how to move the head and neck, and how to place our fingers in trying to ascertain whether the cervical vertebrae are ankylosed. We pass these over, because we place very little confidence in their accuracy or utility.

The professor next notices the influence which the deformity has over the whole organization of the body. An imperfection in the formation of the head is the first and principal effect derived from the infirmity. In cases of wry-neck, he has never seen the face and head altogether well constructed. The half of the face which was nearest to the contracted sternocleido-mastoideus was always smaller, and less prominent, than the other. Frequently the lower jaw, the zygoma, and the eye, were more fink on this side than the other, and hence the countenance presented a very distorted emaciated appearance. The foregoing author has also constantly found the raising of the head, and other motions of this part, materially prevented. The patients always flopped to one side in a most awkward kind of posture. None of them can turn their heads well. Whenever they want to look laterally, they are obliged to turn their whole bodies. Hence many of them become disqualified for certain occupations, and even if they are capable of work, they labour with more difficulty than other persons. The preternatural dragging downward of the head, and the curvature of the cervical vertebrae, one would think (says professor Jörg) would have a bad effect on the functions of the brain and spinal marrow. He has, however, never seen this happen; but on the contrary, in the worst forms of the complaint, he has not found the brain at all affected. Still he does not venture to conclude that things are always so. Our limits oblige us to pass over some other remarks on the preceding topic, in order to begin the consideration of the method of treatment.

We find then that the wry-neck mostly arises from an affection of the muscles, and especially from irregular action in the sternocleido-mastoidei, the equilibrium between which is destroyed; hence the treatment is generally directed against the muscles, particularly those above-mentioned. It is seldom that it is necessary to do anything for the bones. For this reason, the prognosis is generally favorable, and this the more so the younger the patient is, and the more yielding the contracted sternocleido-mastoidei happens to be found. Indeed, when the patient is farther advanced in life, and not more than twenty-five or thirty years of age, we should not totally despair of being able to render assistance, if no ankylosis exist, and not too much deformity of the cervical vertebrae. What kind of a prog-
WRY-NECK.

nosoph can be made, when the bones are originally concerned in the production of a wry-neck, must depend upon the nature and degree of the morbid affection of those parts.

In the treatment of a wry-neck, we must endeavour to soften and relax the contracted muscles, and strengthen those which are stretched and tense. The first indication, Jörg thinks, may be fulfilled by the use of oily emollient liniments two or three times a day; the second by the employment of spirituous stimulating embrocations. When common applications of the last kind are wanting, we are advised to use spirit of ammonia, tincture of cantharides, &c. It is also necessary to persevere for a long time in these remedies, even though the skin may become red and tender. Jörg is an advocate likewise for applying compresses to the parts dipped in such stimulating fluids, and kept constantly wet with them. Thus he calculates on maintaining the effects of their operation without interruption.

If the complaint be considerable in degree, and the head and neck much distorted, we are advised to combine with the foregoing means what are termed *manipulations*, which consist in manual endeavours to obtain an elongation of the contracted muscles, especially the *flerno-cleido-mastoideus*. In these manoeuvres, we are directed to rub with one hand the muscles upwards, and at the same time to try to move the head in the same direction. With the other hand we are to bring the head into its natural position, and keep it there, so that the contracted muscles may be extended as much as possible. The greater their spasmic contraction is, the more must we rub them in the direction above specified, even as long as a quarter or half an hour at a time; and the plan must be repeated once, twice, or thrice a day, until the head will remain quite straight, or until that side of the neck, which was previously convex, has become concave, and *vice versa*. Besides these *manipulations*, the head and face should be moved together into a perfectly upright posture, laterally, and especially towards the side to which they could not be turned, owing to the contracted state of the muscles. By these means, the patient will soon acquire the faculty of moving the neck to one side, which must always be a *defideratum* in the treatment.

Professor Jörg says, he has not deemed it necessary to mention electricity and galvanism as remedies, which may be joined with those above recommended. Whoever likes to try them, however, should only apply them to those muscles which are in a state of tension; for every stimulus must be improper for such as are contracted.

This author does not lay much in favour of the warm bath as a remedy for wry-necks, in which cases he owns he has never made trial of it. All his patients have been children from one to nine years of age; and he thinks it would have been difficult, and even dangerous in some circumstances, to have immersed them sufficiently in the warm water to cover their necks. These are the only reasons which he gives for not having tried so important a remedy for the wry-neck as the warm bath.

One of the principal means for the cure of a wry-neck consists in a mechanical apparatus, by which the head is brought into a straight position, the contracted muscles are elongated, and others, which are on the left, kept in a state of rest and relaxation. It may be said, indeed, that the patient should be able to put his head and neck in this posture himself, and that no mechanical apparatus is requisite. But such posture can only be adopted by making a great effort, and even then imperfectly. Hence the belt inclined patients soon give up the attempt, and the head becomes depressed again. For children who cannot be persuaded to observe regularly the desirable position, the apparatus is more essential than for many adults. Several other writers had entertained this opinion previously to professor Jörg. Köhlers, Bernhein, and other authors, recommend a variety of mechanical contrivances for the cure of the wry-neck. None of these, however, have answered the expectations of professor Jörg, who has felt himself called upon to make an invention of his own. In the construction of his machine, he went upon the following principles: 1. That its operation should be effected by means of a spring. 2. That the action of the stretched enfeebled *flerno-cleido-mastoideus* should be strengthened, and the equilibrium between it and its fellow thereby re-established.

The apparatus consists of a leather pair of flays, and of a band or fillet which goes round the head. On the centre of the fore-part of the flays is a kind of pulley, or wheel, which admits of being turned to the right or left, and then becomes fixed by means of a spring. From this apparatus a band proceeds up the patient's neck to the fillet, placed round the head, and to which it is fastened directly behind the ear, close to the mastoid process. This band lies in the same direction as the lengthened *flerno-cleido-mastoideus* muscle, and when drawn towards the breast by the wheel, it produces the same effect as would arise from an increase of tension in the action of that muscle. In short, it pulls the mastoid process downwards and forwards towards the sternum, counteracts the influence of the opposite muscle of the same name, and thus rectifies the position of the head.

But this band, says professor Jörg, does not merely draw down the side of the head which is too elevated, it also tends to put the neck in a straight position. It was above explained, that a wry-neck is always more or less twisted, in consequence of the contraction of one of the *flerno-cleido-mastoidei*, and thus the mouth does not lie in a direct line perpendicularly above the centre of the sternum, but to one side of this point. The action of the preceding band, by drawing forwards as well as downwards towards the middle of the breast, the mastoid process evidently tends to counteract the effect produced by the wrong action of the faulty muscle of the opposite side.

Professor Jörg makes his patients wear the apparatus day and night, and he does not even take it off when the frictions are made. The band is to be tightened and regulated according to the effects produced. Particular care, however, must be taken not to make it too tight at first.

When by perseverence in the use of this apparatus, and the other means above recommended, the neck has been put into a proper position again, it usually happens that the head itself continues inclined too much forward; an effect which the contracted *flerno-cleido-mastoideus*, and its antagonist, the band, both tend to promote. Something, therefore, must be done for the alleviation of this deformity. With this view, Jörg removes the above band from the breast, carries it under the arm, and through a ring at the side of the leather flays or corsets, and thence to the fillet round the head, where it is fastened in the same place as before. In this manner, the head will be considerably elevated, while still the object of counteracting the shortened *flerno-cleido-mastoideus* of the opposite side is not neglected. The ring hinders the band from hurting the axilla, and keeps it from following the motions of the shoulder. The preceding author lets his patients, towards the latter part of the treatment, wear the apparatus in this way a long while; yet sometimes he applies it in both modes alternately, with a design
a design of habituating the muscles of the head and neck to different postures.

Together with this treatment, professor Jörg enjoins attention to every thing which tends to improve the health, especially a proper nourishing diet, pure air, &c. One thing he insists upon as essential, viz. that during work or repose, sleeping or awake, the patient constantly keep the head and neck in the right position. Hence children must be most vigilantly observed, as they soon forget what is told them; and the posture in which they lie when asleep must be attended to, as it is frequently a bad one. Jörg recommends laying their heads on firm round bolsters filled with horse-hair, and placing them on the side on which the muscles are contracted. The bed should be flat, and not slant, in order that the shoulder may not be depressed.

In this position, the head will be pressed and inclined towards the opposite side. The patients must also be forbidden to do any kind of labour which will oblige them to hold their heads in a hurtful position; but Jörg rather commends dancing and the military exercise, as accustoming the patient to hold his head as he ought to do.

When the bones are concerned, the above apparatus and treatment will not be effectual; and particular machinery adapted to the case must be employed.

Frequently the curative means are prematurely discontinued, and the disorder recurs. It is commonly imagined, that when the head and neck can be brought straight, every thing is accomplished. But, as Jörg remarks, it is wrong to consider this period the completion of the cure; for, when the head and neck can be kept every day several hours in a right posture, without any machinery, the convalescents soon become fatigued, as it cannot be at first done without exertion. It is only when both sterno-pleideo-mafoidei seem to be formed alike; when one is not tender than the other; and when, consequently, the equilibrium between them is re-established; when also one side of the neck is as prominent and well-formed as the other; and when the head can be brought into the right position naturally, and without any effort; that the cure ought to be regarded as accomplished. The machinery may now be gradually relinquished with safety. At first it is to be taken off for an hour at a time every day, and the period of its discontinuance is to be lengthened by degrees, until at length it is entirely laid aside. For the foregoing excellent observations we are indebted to professor Jörg of Leipzig, whose publication on the deformity of the human body is entitled in German "Ueber die Verkrümmungen des Menschen Körpers und eine rationale und sichere Heilart derselben." Leipzig, 1816, 4to.

This author has not mentioned or given any opinion respecting the plan which was proposed by Mr. Sharp, of dividing and even cutting out a portion of the sterno-pleideo-mafoideus muscle, which appears to act with too much power.

Mr. Gooch cured a patient by merely dividing the skin and platysma myoides muscle; a kind of cafe which Jörg thinks unfrequent. Mr. Gooch also sometimes employed machinery with success.

WRY-NECK, a disease of the spasmodic kind in sheep, in which the head is drawn forcibly to one side, and the animal disabled from walking. The cure is to be effected by the use of calomel with opium in pretty full doses; putting the animal into a dry well-grafted pasture during the time, and avoiding cold and moisture.

WRY-NECK, Jynx, in Ornithology, a bird called also the torquilla, which Linnaeus has made a distinct genus of the fric, under the denomination of jynx; the characters of which are, that the bill is slender, round, and pointed; the nostrils are concave and naked; the tongue is very long, very slender, cylindric, and terminated by a hard point; and the feet are formed for climbing.

There is only one species, viz. the jynx torquilla. The colours of this bird are elegantly pencilled, though its plumage is marked with the plainest kinds: a lift of black and ferruginous strokes divides the top of the head and back; the sides of the head and neck are ash-coloured, beautifully traversed with fine lines of black and reddish-brown; the quill-feathers are dusky, but each web is marked with rust-coloured spots; the chin and breast are of a light yellowish-brown, adorned with sharp-pointed bars of black; the tail consists of ten feathers, broad at their ends and weak, of a pale ash-colour, powdered with black and red, and marked with four equidistant bars of black: the irides are of a yellowish colour.

The wry-neck, Mr. Pennant apprehends, is a bird of passage, appearing with us in the spring before the cuckow. Its note is like that of the kestril, a quick-repeated squeak: its eggs are white, with a very thin shell; this bird builds in the hollows of trees, making its nest of dry grafts. It has a very whimsical way of turning and twirling its neck about, and bringing its head over its shoulders, whence it has its name torquilla, and its English one of wry-neck: it has also the faculty of erecting the feathers of the head like those of the jay. It feeds on ants, which it very dexterously transfixes with the bony and sharp end of its tongue, and then draws them into its mouth. Ray and Pennant.

WRYNOSE, in Geography, a mountain of England, on which are three stones, marking the boundaries of the three counties of Lancaster, Cumberland, and Westmoreland; 12 miles S. of Ravenglafs.

WSCHESTAD, a town of Bohemia, in the circle of Kauzim; 10 miles N.W. of Kofelczet.

Westin, a town of Moravia, in the circle of Hradisch; 23 miles N.E. of Hradisch.

WULFENS. See Wippening.

WULDA, a town of Bohemia, in the circle of Bechin; 12 miles S.W. of Cramau.

WULFEN, a town of Westphalia, in the bishopric of Osnabruck; 8 miles E.N.E. of Osnabruck.

WULPEN, in Botany, was so named by professor Jaucquin, in honour of his highly deserving friend, and constant botanical correspondent, the Rev. Francis Xavier von Wulfen, professor of natural philosophy and mathematics at Klagenfurt, in Carniola, to which charge he was appointed in 1762, and where he died March 17, 1806, aged seventy-eight. Amid the duties of his professorship, and the more serious calls of his ecclesiastical station, which he fulfilled by the most exemplary and active benevolence and charity to all within his reach, his favourite pursuit was the study of the botany and mineralogy of the surrounding country. His numerous contributions to the publications of Jaucquin, on the rare plants of Carniola and Carinthia, constitute a treasure of the most valuable and original information. He writes with the ardour of a true lover of nature, and we have nothing to disapprove, except somewhat of the diffuse, and what Linnaeus terms "oratorical," style, in the descriptive parts of his writings, where terseness and precision are most desirable, however agreeable the graces of oratory, and the expression of taste and feeling, may be in any accompanying remarks. The Flora Lapponica of Linnaeus is our standard of perfection in this respect. Wulfen was an accomplished scholar, a man of the most amiable and elevated character, who adorns every thing that he touches, and
and who lived and died beloved and revered by men of all ranks, and of every persuasion. As he lived remote from the scientific circles of Europe, it is no wonder if, in the abstruse study of cryptogamic botany, he fell into some errors, especially relative to the Lichen tribe, a part of which the writer of this article presumed to correct, in a paper printed in the Transactions of the Linn. Soc. v.2. p.10, certainly without intending any disrespect for the excellent author, though a German writer of a more vulgar stamp, by mis-translation and mis-representation, tried to excite them to enmity, but in vain. He may be pardoned for the sake of the great man whom he, though unskilfully, meant to defend, and for his own services to science, though of inferior pretensions. Wulfen is reported to have left behind him in MS. a complete Flora Nica, descriptive of the vegetable productions of a particular part of Carniola, an Agrobotgraphia, and several other works, rich in practical and scientific observations. Of these, it is to be hoped the learned world will not be deprived.—Jacq. Misc. Austr. v.2. 62. (Paderota Ageria; Linn. Mant. 171, excluding Bahuin's synonym.) Wildl. Sp. Pl. v.1. 78. Vahl Enum. v.1. 86. Mart. Mill. Dict. v.4. Sm. Transf. of Linn. Soc. v.6. 96. (Bonarota; Mich. Gen. p.15. Paderota; Juff. 120. Lamarck Dict. v.4. 692. Illustrio. t.13, but not the original Paderota of Linnaeus. See Tr. of Linn. Soc. as above.—Clas and order, Dianthus Monograph. Nat. Ord. Perfonata, Linn. Scrophularia, Juff. Gen. Ch. Cal. Perianth: inferior, of one leaf, in five deep, linear-awl-shaped, equal, erect, permanent segments. Cor. of one petal, ringent: tube gibbous, and nearly globose at the base: limb two-lipped; upper lip short-telt, undivided, or slightly notched, vaulted, acute: lower longest, deflexed, three-lobed. Stam. Filaments two, thread-shaped, ascending, shorter than the upper; anthers roundish. Pfl. German superior, ovate-oblong, compressed; style thread-shaped, twice as long as the calyx; stigma capitate. Peric. Capsule ovate, compressed, furrowed at each side, of two cells and two divided valves, bursting at the summit. Seeds numerous, roundish. Eff. Ch. Corolla tubular, ringent; upper lip vaulted; lower three-cleft. Calyx in five deep segments. Capsule of two cells, and two cloven valves.

Obs. This genus is certainly next akin to Veronica, under which article we have recorded a remark to that effect made by Mr. Brown. The essential difference, however, between these two genera resides in the limb of the corolla, which in Veronica is wheel-shaped, its lower segment narrow; a character of more importance than the proportion of the tube, that part being, in a few species, nearly as much elongated as in the present genus. If any of those species should prove to have a ringent corolla, whose upper lip is vaulted, and the lower three-lobed, they must be removed to Wulfenia; but we do discover nothing of this in V. fibrica or virginica, whose limb is truly that of a Veronica. Whether the throat be bearded in every species of Wulfenia, we are not certain; nor is that circumstance material, any more than the valves of the capsule being cloven or not, the same difference existing between different species of Veronica, as has already been mentioned in its proper place. The five-cleft calyx, indicated by Linnaeus as the mark of Paderota, is found in the two Veronica jult named, as well as in some less ambiguous species, as V. austriaca, multifida, Teucrium, and latifolia, though in these last the fifth segment varies in size, is occasionally absent, and is always unequal to the others.

1. W. Bonarota. Blue Leafy Wulfenia. Sm. n. 1. Vahl n. 1. (Paderota Bonarota; Linn. Sp. Pl. 20. Wildl. Sp. Pl. v.1. 77. Jacq. Aultr. append. t.39. P. cerulea; Linn. Suppl. 84. Lamarck Illustrio. v.1. 48. t.13. f.1. Bonarota montana italicca, chamadrys folio, flore ceruleo; Mich. Gen. 19. t.15. f.1; also f.2, with rounder leaves, and a more dense spike. Chamadrys montis Sumani; Bauh. Hist. v.3. 289.)—Stem leafy. Upper lip of the corolla entire. Leaves roundish-ovate.—Native of the mountains of Italy and Carniola; perennial: a stranger in our gardens, as well as the following. The root is somewhat creeping. Stems simple, erect, five or six inches high, downy like the rest of the herbage, each bearing four or five pair of roundish-ovate leaves, about an inch long, with broad, rather shallow frutatures. Cluster terminal, solitary, ovate-oblong, of several pretty blue flowers, accompanied by lanceolate bracteas. Calyx hairy. The corolla is decidedly ringent, with a concave upper lip, and the valves of the capsule split at the summit, each into two sharp points.

2. W. Ageria. Yellow Leafy Wulfenia. Sm. n. 2. Vahl n. 2. (Paderota Ageria; Linn. Mant. 171, excluding Bahuin's synonym.) Wildl. Sp. Pl. v.1. 77. P. lutea; Scop. Ann. 2. 41. Lamarck n. 3, excluding the reference to Bahuin. Linn. Suppl. 84. P. Bonarota; Jacq. Hort. Vind. v.2. 55. t.121. Bonarota montana italicca, chamadrys folio minus crenato, fpica lutea; Mich. Gen. 19.)—Stem leafy. Upper lip of the corolla cloven. Leaves ovolato-lanceolate, elongated at the point.—Native of Carniola and Italy, in places where, according to Scopoli, the former is not found. Great confusion respecting these two plants has long existed. Linnaeus and Scopoli sometimes considered them as varieties of each other, and when they made them distinct, they misapplied their synonyms. The present is said to be distinguished by the emarginate, or cloven, upper lip of the corolla, which, nevertheless, Jacquin's figure does not express, and which is but slightly perceptible in our dried specimens. The leaves differ materially in their more elongated form, and narrower, more copious, frutatures; the lower ones being alternate, as noticed by Scopoli, is but a casual occurrence. The corolla is of a pale sulphur-colour, not blue. Calyx smooth. The style in both these species is short as long in proportion to the calyx and corolla as in the following, though described, in the generic character of Paderota by Linnaeus, as only the length of the flaments.

The specific name of Ageria, given by Linnaeus to what had much better have been called lutea, is intended to commemorate Nicholas Agerius, a friend of John and Caspar Bauhin, who sent our W. Bonarota to the former, and is mentioned by him in several places. His name occurs in Linn. Sp. Pl. 1670, as the original discoverer of Verbotum Thaphi. Haller speaks of himself as having published, at Strasbourg, in 1625, a quarto dissertation de Zoophyta; and another in 1629, de Animia vegetativa; works not mentioned in Sir Joseph Banks's rich catalogue, and therefore, doubly, very rare.

3. W. carinthiaca. Carinthian Wulfenia. Sm. n. 3. Wildl. n. 1. Vahl n. 3. Jacq. Misc. Austr. v.2. 60. Carin. t.2. (Paderota nudicaulis; Lamarck Dict. v.4. 692. Illustrio. v.1. 48. t.13. f.2.)—Stem naked. Leaves crenate.—Found by Wulfen, in a rich soil, among limestone rocks, on the loftiest and most craggy mountains of Carinthia, flowering in the middle of July. The root is creeping, perennial, half as thick as the middle finger. Leaves several together in a tuft, all radical, obovate, obtuse, four or five inches long, doubly or unequally crenate, smooth and shining, except the strong mid-rib, which is hairy at the back; their base tapering into a winged footstalk. Flowers
Flowers large and handsome, of a fine blue, crowded numerously into a dense cluster, supported by an upright, round, firm, unbranched, leafless, though somewhat scaly and slightly hairy, solitary, radical stalk, twice or thrice the height of the leaves. After flowering, the cluster becomes three or four inches long, and the permanent calyx turn reddish. The calyx are each one-third of an inch in length, brown, abrupt, scarcely exceeding the calyx, soon splitting into four parts at the top. The error of the specific name in Lamarck's synonym, P. Wulfenia, for P. nudicaulis, in Vahl and Willdenow, is copied by the former from the latter.

WULFRADT, in Geography, a town of the duchy of Berg; 3 miles N.E. of Medman.

WULFSORD, a town of the duchy of Holstein; 11 miles N.N.W. of Lubeck.

WULTSFELDE, a town of the duchy of Holstein; 12 miles N.W. of Lubeck.

WULFFEN, a town of Wellphalia, in the bishopric of Osnabruck; 2 miles S.W. of Osnabruck.

WULLED, a town of Arabia, in the province of Yemen; 46 miles S.E. of Loheia.

WULLERSDORFF, a town of Austria; 2 miles S.E. of Guderntorf.

WULLI, Mountains of, mountains of Persia, which extend from the vicinity of Shatzen, across to the lake of Vaikind, and form one range with that on the N. of Mecklen, called Gehelabad by La Rochette.

WULPERODE, a town of Wellphalia, in the principality of Halberstadt; 4 miles W. of Osterwick.

WULTZESHOFFEN, a town of Austria; 1 mile S.W. of Laa.

WULVESHEVED, or WULVESHEAD. See WOLSHEED.

WUMBLE, in Rural Economy, the provincial name of an auger. It is sometimes written wumlele and wimble.

WUMME, in Geography, a river of the duchy of Bremen, which runs into the Wefer, about 6 miles N.W. of Bremen.

WUNALCHIKOS, a tribe of Delaware Indians.

WUNNENBERG, a town of Wellphalia, in the bishopric of Paderborn, which received its name from a victory which Charlemagne gained in the year 794 over the Saxons; 14 miles S. of Paderborn. N. lat. 51° 29'. E. long. 8° 9'.

WUNSCHELBERG, or Hradec, a town of Silezia, in the county of Glatz. Here are manufactures of thread, cloth, and variety of fluffs; 10 miles N.W. of Glatz. N. lat. 50° 19'. E. long. 16° 15'.

WUNSCHUECH, a town of Stiria; 8 miles S. of Gratza.

WUNSEES, a town of Germany, in the principality of Bayreuth; 13 miles W. of Bayreuth.

WUNSIEDEL, a town of Germany, in the principality of Bayreuth, on the Fichtelberg; near it are mines of copper and iron, and quarries of marble; 34 miles E. of Bayreuth. N. lat. 50° 3'. E. long. 12° 3'.

WUNSTORF, a town of Wellphalia, in the principality of Calenberg, the chief place of a county, which became extinct in the year 1533; 10 miles W.N.W. of Hanover. N. lat. 52° 27'. E. long. 9° 32'.

WUNT, in Agriculture, a term provincially applied to the mole.

WUNTHILSACK, a word signifying a mole-hill. See MOL and MOLLE-HILL.

WUNTZ, in Geography, a town of the county of Hesseberg; 6 miles N.W. of Meinungen.

WURBEN, a town of Silezia, in the principality of Schweidnitz; 4 miles N. of Schweidnitz.

WURBENTHAL, a town of Silezia, in the principality of Troppau; 13 miles W. of Jajerdorf. N. lat. 49° 57'. E. long. 17° 15'.

WURF, in Commerce, a denomination distinguishing a certain quantity of inferior silver coins in Germany; thus, a wurfe denotes 5 pieces of 17 or of 7 creutzers; and 12 wurf of 17 creutzer pieces make 1 florin, and 12 wurf of 7 creutzer pieces make 7 florins.

WURGLAU, or GUERGLA, in Geography. See WERGELA.

WURL, a river of Wellphalia, which runs into the Ems, near Rietberg.

WURLITZHAIDT, a town of Germany, in the principality of Culmbach; 7 miles S.E. of Hof.


Gen. Ch. Cal.: none; unless, like Thunberg, we take the corolla for such. Cor. of one petal, tubular, permanent: tube with five angles, abrupt at the base; limb in five deep, lanceolate, acute, equal, erect, or spreading segments, usually about the length of the tube. Stam. Filaments five, thread-shaped, erect, inserted into the mouth of the tube, and shorter than the limb; anthers roundish, of two lobes. Pfl. German superior, triangular, furrowed, smooth; flyles three, awl-shaped, triangular, the length of the filaments; stigma obtuse. Peric. Capsule invected with the withered corolla, oblong, with three angles and three furrows, consisting of three cells, separating from the top half way down. Seeds numerous, round.


Obs. Under the genus Melanthium, (see that article,) we have expressed a determination of reducing the present genus to that. By a casual oversight, however, the species which compose Wurmbea were there omitted. Having examined them with more attention, and particularly with respect to Ornithoglossum, which the reader will find in its proper place, our opinion has changed. The latter genus, to which Melanthium indica perhaps really belongs, has most resemblance to Wurmbea in habit, and in the general aspect of the flowers; though most widely estranged therefrom in its generic character, founded on the inflorescence of the flowers. If Ornithoglossum be retained, Wurmbea must. No difficulty attends its essential character, which is obvious enough, in the pale hexagonal tube, abrupt or gibbous at the base, as if furnished with fix small spurs. The Linnaean herbarium shews, that Linnaeus himself had established the present genus, and dedicated it to his friend Psparrmann, by whom his specimens were brought to Europe. There is a singular remark in Thunberg, of Wurmbea having, “without all doubt,” been produced from Melanthium eulatum!
three or four flowers. Tube the length of the limb.—

Native of the Cape of Good Hope, in sandy ground, at the foot of small hills, flowering in August or September. The root is a small globular bulb, as in all the rest, sink deep into the earth. Whole herb but an inch high, with two or three short, feathering, lanceolate leaves. Clusters hardly rising above the foliage, of three or four, rarely more, erect white flowers, on longish partial stalks, not sessile, or if sessile, if Thunberg's figure be correct, like the other species. The margins of the segments of the flower are purple, and there are spots of the same colour just above the mouth of its tube. The filaments are white. Thunberg.


Native of the same country. Sent to Kew garden, by Mr. Maffon, in 1788. It flowers in the green-house in May and June. The bulb is ovate. Stem solitary, little, leafy, from three to five inches high; zigzag, tapering, and pale, in the part which is below the surface of the ground. Leaves three or four, alternate, widely spreading, or recurved, much longer than the limb, but not elevated above it, tapering, channelled, rather glaucous, smooth; their base dilated and sheathing. Spike terminal, erect, two or three inches long, of numerous, sessile, white flowers, whose limb is rather concave, its edges brown in our specimens, anwering to Thunberg's description, though that circumstantial is not expressed in the Botanical Magazine. Stamens white, spreading, not half the length of the limb, with yellow anthers.


Native of the Cape. Sent to Kew in 1788, by Mr. Maffon. This has the herbage of the last, but the spike is rather more lax, and the flowers all over of a dark violet-purple, except the yellow anthers, have a much shorter tube, and longer limb.

4. W. longiflora. Long-flowered Wurmbea. Wild. n. 3. (W. capensis; Hugh. Nov. Gen. 19. t. 1. f. α. Lamarck f. 2.)—Spike taller than the leaves. Tube of the corolla twice the length of the limb.—Found at the Cape of Good Hope, on sandy hills in various places. A taller larger plant than any of the preceding; its leaves much broader at the base. Spike three or four inches long, rather lax, many-flowered, with a zigzag angular stalk. Flowers entirely white; their tube near an inch long; limb about half that length, widely spreading. Stamens full half the length of the limb. That all these species should have been considered as varieties only, appears as strange as any other particular in the history of the present genus. The Linnaean herbarium proves the Melanthium monocetalum of the Supplement to be not this, but the W. campanulata.

WURMBERG, in Geography, a town of the duchy of Stiria; 6 miles N.W. of Pettan.

WURMSEE, a lake of Bavaria; 13 miles S.W. of Munich.

WURST, a Russian measure. See WERST.

WURSERE, in Geography, a town of Hindoostan, in Guzerat; 32 miles N.E. of Chitpore.

WURTEMBERG, late a duchy and now a kingdom of Germany, bounded on the north by the Rhine of Vol. XXXVIII.
ments, that no change or innovation should be made in the Lutheran religion in any part of the whole duchy, and that in all the churches and schools throughout the duchy, and the countries thereto belonging, no other religion than that of Lutheranism should be taught: that no Catholic churches, chapels, altars, or images, should be erected or set up, nor any such as were decayed or forsaken again used. The Calvinists only are tolerated here, and their place of worship at Stuttgart is a private house. In this duchy are also some Waldenfes, who are either husbandmen or farmers, and live in the Italian villages, as they are called, some few towns alone excepted; where they have established manufactures of hats and stockings, and are allowed the public exercise of their religion. The toleration of the Jews here was abolished by an edict of duke Christophcr, that of two or three families at Stuttgart excepted, under the particular protection of the court. The church is governed by four superintendents, styled abbots, and 38 rural deans; a synod is annually held in the autumn. Education, and particularly that of ecclesiastics, is favoured by laudable institutions; the seminary of Tubingen used to accommodate about 300 students; and at Stuttgart there is a public academy. Here are manufactures of pottery, glafs, woollen, linen, and flax, which, with the natural products of the country, supply a considerable export. The imports are by Frankfort on the Maine. The chief city is Stuttgart, and the second town is Tubingen. The other towns are numerous, but small; and the villages are thickly placed in a populous and flourishing country. The origin of the princely house is somewhat obscure and uncertain. It is certain, however, that there were counts of Wurtemberg at the beginning of the twelfth century. In 1802 Wurtemberg was created an electorate of the empire; and in 1806 was erected into a kingdom. The capital of Wurtemberg, which gave name to the duchy, is situated 4 miles E. from Stuttgart. By the treaty of Prensburg in 1805, the king of Wurtemberg acquired several important reserves.

WURZBURG, a town of Germany, in the county of Erbach; 3 miles E. of Erbach.

WURZEN, a mountain of Carinthia; 8 miles S. of Villach.

WURWAMA, a town of Hindostan, in Guzrat, on the south side of the gulf of Cutch; 40 miles N.E. of Noongur.

WURWAY, a river of North Wales, which runs into the Vurney, 3 miles S. of Llanvilling, in the county of Montgomery.

WURZACH, a town of Germany, in the county of Waldenburg, on the Aitch; 26 miles N.W. of Kempten. N. lat. 48° 0'; E. long. 9° 52'.

WURZBACH, a river of Germany, which runs into the Klein Enz, 2 miles E. of Wildbad.

WURZBURG, a duchy, late a bishopric, bounded on the north by the county of Henneberg and principality of Coburg; on the east by the bishopric of Bamberg, the margravate of Ansbach, and the county of Crett; on the south by the county of Hohenlohe; and on the west by Mergentheim, county of Wertheim, electorate of Mentz, and the bishopric of Fulda; about 80 miles in length, and 64 in breadth. The territory of Wurzburg is fertile in corn, pastures, and divers sorts of fruits and plants, as also in wine, the very best Franconian wines growing in it. The prevailing religion is the Roman Catholic; but there are also Lutheran and Calvinist churches within the ecclesiastical jurisdiction and territory of Wurzburg, which from time to time preferred to the diets of the empire grievous complaints of oppression and injustice. In the sixteenth century, this bishopric abounded with Protestant inhabitants. The bishopric was not founded here till 741. In the year 1752, pope Benedict XIV. granted them the privileges of bearing the archiepiscopal pall and crofs; but in other respects they were suffragans to the archbishops of Mentz. This prince and bishop maintained five regiments of foot and horfe, military affairs being subject to the aulic council of war. In 1806 Wurzburg was secularized, soon after erected into a duchy, and given to the archduke Ferdinand. The number of inhabitants is computed at 200,000. By the treaty of Prensburg in 1805, the new kingdom of Bavaria, to which Wurzburg had been before assigned, acquired several important additions.

WURZBURG, a city of Germany, and capital of a duchy, late residence of the bishop. It is situated on the Maif, well fortified, and defended by a fortrefs, situated on a rock without the town; in which fortres is an episcopal palace, and a church, suppos'd to be the oldft in Franconia. The town is divided into four quarters and four suburbs, in which are, a new palace, built in the beginning of the eighteenth century, a cathedral, several collegiate and parish churches, colleges, abbeys, and convents. The university was founded in the year 1403; and, after falling to decay, restored again in 1582. In August 1796, Wurzburg was taken by the French, but given up to the Anfrians the month following; 50 miles E.S.E. of Frankfort on the Maine. N. lat. 45° 50'; E. long. 9° 59'.

WURZELBAU, or WURZELBAU, JOHN PHILIP, in Biography, a German altronomer, was born at Nuremberg in 1651, and being diverted from his studies by a change of circumstances, devoted himself to mercantile purfuits. But in the middle of these occupations, he reserved for hours for reading, and acquainting himself with the French, Italian, and Spanish languages. His chief attention was directed to mathematics and altronomy. In 1684 and 1685 he made observations on an eclipse of the moon, which were printed; and in 1699 transmitted to the Royal Society communications pertaining to altronomy. In 1691 devoting himself more sedulously to the study of geometry and altronomy, the emperor Leopold, apprized of his merits, raised him and his heirs to the rank of nobility in 1692. In 1699 he was chosen one of the foreign associates of the Academy of Sciences at Paris, and in 1706 he became a member of the Academy of Berlin. Declining a removal to Drefsden, with the offer of an annual salary of 1000 dollars and free lodging, he occupied himself in astronomical observations with instruments of his own invention and construction; and he built, at his residence in Nuremberg, an observatory consisting of an octagon tower, covered with copper, and resting on iron bars, which was placed on the top of the house, and which was moveable to every part of the heavens; it was furnished with an azimuth quadrant of five feet radius, a sextant of fix feet, and other instruments; of which observatory he published an account at Nuremberg, 1697, fol. He published also other works, ibid. 1713, fol. and ibid. 1719, fol. Having published solar tables, &c. he died at Nuremberg in 1725. He published also various observations in the Phil. Trans. vol. xv. xvi. xvii. and vol. xxx.; and also at Nuremberg. Montucla. Weidler. Gen. Biog.

WURZEN, or WURZEN, in Geography, a town of Saxony, in the territory of Leipsic; the bailiff of which extends over seventy-fix villages, and twenty-two noble eifates; anciently the fee of a bishop, but in 1661, the eifates of the foundation were annexed to the Leipsic circle. The town is situated on the Mulda; though not large in itself, it is much increased by its fauxbourgs, which contain
the citadel and cathedral. The beer brewed here is the chief article of trade, and is exported in great quantities; 14 miles E. of Leipzig. N. lat. 51° 19'. E. long. 12° 42'.

WUSEN, a town of Prussia, in the province of Ermland; on the Paflarg; 25 miles W. of Heilberg.

WUSHTOEE, or MEGEH, a general term applied to all that country of the province of Mekran in Peria, lying to the westward, and on the parallel of Punjgoor or Panger, and forming the northern boundary of the Sandy Desert. It is represented to be a mountainous district, producing in some of its villages grain, sufficient for the consumption of the few wandering shepherds who inhabit them. Water is plentiful, except in April, May, and June; dates are also produced, and camels, sheep, and goats, are procurable, but not in great number. The people are rather a small delicate race: their arms are, a match-lock, fowrd, and shield: and each village has its own chief, who settles disputes that arise among the inhabitants.

WUSLACH, a town of Prussia, in the province of Ermland; 10 miles E. of Heilberg.

WUSTEN SAXEN, a town of Germany, in the principality of Wurzburg; 5 miles N. of Bischofsheim.

WUSTERHAUSEN, a town of the Middle Mark of Brandenburg; 11 miles S.S.E. of Berlin.—Alslo, a town of the Middle Mark of Brandenburg, on the Dole; 36 miles N.W. of Berlin. N. lat. 50° 53'. E. long. 12° 31'.

WUSTERSDORF, a town of Austria; 9 miles S.W. of Laab.

WUSTHAL, a town of Germany, in the circle of the Lower Rhine; 4 miles N. of Rothenbach.

WUSTRO, a town of Welfphalia, in the principality of Luxemburg Zelle, on the Jetze and the Dummie; 40 miles S.E. of Luxemburg.

WUTACH, a river of Germany, which crosses the county of Stuhlingen, and runs into the Rhine, 10 miles below Lausenberg.

WUTTOOR, a town of Hindoostan, in Dowatabad; 6 miles E. of Junere.

WUTZKOW, a town of Hinder Pomerania: it is the last port flage bordering on Poland; 30 miles E. of Stolpe.

WYACONDA, a river of Louisiana, which runs into the Missisipp, N. lat. 36° 46'. W. long. 91° 48'.

WYALUSING, a township of Pennsylvania, in the county of Luzerne, with 576 inhabitants; 320 miles N. of Washington.

WYALUSING Creek, a river of Pennsylvania, which runs into the E. branch of the Susquehanna, N. lat. 41° 40'. W. long. 76° 20'.

WYANDOT, a town of North America, belonging to the United States: a tribe of Indians called Wyandots inhabit the neighbourhood; 6 miles S. of Sandusky.

WYASTON, a village in the hundred of Appletree, Derbyshire, England, situated 3 miles from Ashborne, and 137 from London. In the year 1811 it contained 16 houses, and 69 inhabitants.

WYAT, Sir Thomas, in Biography, an English poet, was the son of Henry Wyat, esq. of Allington-castle in Kent, and born in 1523. Having limited his education at Cambridge and Oxford, he travelled, as an envoy, into various parts of Europe, and acquired the favour of Henry VIII., whose good will was of very short duration; for either from a fulmination of his connection with Ann Boleyn, or the ill offices of Bonner, he was for some time imprisoned. After his liberation he retired to his castle of Allington, and being employed to conduct the ambassador of Charles V. from Falmouth to London he was seized with a fever, of which he died at Sherburn in 1541. In an elegy on his death, his character was highly drawn in an encomium by the earl of Surrey, with whom he was intimate, as his fellow-labourer in polishing English poetry; though his strains are said to have been inferior to those of the earl of Surrey. Mr. Watton distinguishes him by the appellation of the first polished English satirist. His reputation was high, and Leland published a book of Latin verses on his death. His poems were printed with the editions of those of Surrey in 1559 and 1565, and since by Dr. Sewell, in 1717. His version of David's Psalms is much commended by Surrey and Leland; but it is not extant. Watton's Hist. of Eng. Poetry. Gen. Biog.

WYBERTON, in Geography, a village and parish in the wapentake of Kirtom, Holland division of the county of Lincoln; 2 miles from Bolton, and 115 from London. It was returned in the year 1811 as containing 76 houses, occupied by 353 persons.

WYCHBOLDS, a village in the hundred of Barford, Bedfordshire, England, situated 8 miles from Bigglewade, and 2 miles from St. Neot's. The population is not separately returned, being included in the parish of Eaton-Socor.

WYCHBORG. See WYDBORG.

WYDBURN, or WISBURN, a village in the hundred of Nampwich, county palatine of Chelfer, is situated on the borders of Staffordshire, about 3 miles E. from Nampwich. The church is a handsome structure, and contains a great variety of monuments and other topographical memorials. A school was built here nearly two centuries ago by subscription; the endowments are but small, though increased by occasional donations: the school is for boys, some of whom are taught reading only, others reading, writing, arithmetic. The population return of the year 1811 states this village to contain 76 houses, and 353 inhabitants. The parish of Wydburn is very extensive, and comprehends eighteen townships.—Lyfons's Magna Britannia, vol. ii. Chelfer, 1810.

WYCH-House, a house in which salt is boiled. (See SALT.) In the places where there are salt-springs, and salt-works are carried on at them, the work-house where the salt is made is always called the wych-house; and hence we may naturally conclude that wych was an old British word for salt, which is the more probable, as all the towns in which salt is made end in wych; as Nampuywch, Droytwyth, Middlewyth, &c.

WYCHERLEY, William, in Biography, was born at Cleve, in Shropshire, about the year 1640; and in France, whither he went for his education, he conformed to the Roman Catholic religion. Upon his return to England a little while before the Restoration, he entered, without matriculation, as a gentleman-commoner at Queen's college, Oxford, and leaving it without a degree, took chambers in the Middle Temple. However, he abandoned the law, and addicted himself to the composition of comedies, the first of which was entitled "Love in a Wood, or St. James's Park," which brought him into notice in 1672; so that he became a favourite of the duchess of Cleveland, and of Villiers, the duke of Buckingham. He was also honoured by the attention of the king, and by promises of future promotion. His majesty, however, was displeased by his marriage with the countess of Drogheda, and the connection was unhappy. On occasion of her death, however, he settled her whole estate upon him, and his title being disputed, he was involved in law expenses and other incumbrances, which occasioned his being committed to prison. Having remained in prison for seven years, he was liberated by king James II., who, delighted by seeing his comedy of
of the "Plain Dealer," gave orders for the payment of his debts, and settled upon him a penion of 200l. a year.

His circumstances were still embarrased, and though by his father's death he became a tenant of the estate to which he succeeded, he was not emancipated from his difficulties. Some time after he married a young woman, on whom he settled a jointure of 1500l., humourously italicising with her that she should not take an old man for her second husband, which condition, it is said, he promised faithfully to observe. He died in 1715, at the age of 75.

Before the two comedies already mentioned, he composed "The Gentleman Dancing-Matter," and "The Country-Wife." The last and the Plain Dealer are said to be the most noted. His plays, though commended by lord Rochester, are strongly marked with his own character,—"some wit and strength of delineation, with much coarseness and licentiousness." He attacks vice, it is said, with the severity of a cynic, and the language of a libertine. A volume of poems published in 1704 was so unsuccessful, that he applied to Pope, who was a mere youth, to correct the verification. Dr. Johnson remarks, that "when Pope was sufficiently bold in his criticisms, and liberal in his alterations, the old scribbler was angry to see his pages defaced, and felt more pain from the detection than content from the amendment of his faults." The posthumous works of Wycherley, in prose and verse, were published by Theobald in 1728, 1729, but they are utterly forgotten. Biog. Brit. John- son's Life of Pope. Gen. Biog.

**WYCK**

WYCK, John, was the son of Thomas Wyck, a painter of shipping and views of towns, of no very great celebrity, who was in England in the time of Charles II. John was born at Haarlem about the year 1640, and distinguished himself as a painter of battles and sieges, and sometimes of hunting and processions. He imitated the style of Wouvermans and Vander Meulen, but never obtained their neatness or finish, though his colour is oftentimes very agreeable. His execution is better upon a small than a larger scale. He died at Mortlake in 1702.

WYCK, in Geography, a part of the city of Maestricht, on the E. side of the Meuse, strongly fortified. See MAES- TRICH.-Also, a small sea-port of Suffolk, on the W. coast of the island of Efl.

**WYCK op Zeen**, a town of Holland, near the sea; 3 miles W. of Beverwick.

**WYCK op Duerrloede**, a town of Holland, in the department of Utrecht, supposed to be mentioned by Tacitus, by the name of "Batavodurum," and said to have been built by Batius, prince of the Catti. It was granted, with its territory, to Rixfride, the seventh bishop of Utrecht, and his successors, for the zeal he had shewn in converting the infidels. Thrimenis relates, that it was anciently three leagues in circumference, and had 55 parochial churches, and that it had been destroyed by the Normans and Danes three several times; 13 miles S.E. of Utrecht.

**WYCLIFFE** is a small village and parish in the wapentake of Welf Culing, North Riding of Yorkshire, England, is situated two miles N.E. from Great-bridge; and in the year 1811 was returned as containing 26 houses, and 140 inhabitants.

**WYCOMBE**, High, or Chipping-Wycombe, a large market and borough town in the hundred of Desborough, Buckinghamshire, England, is situated 34 miles S.S.E. from the county town, and 29 miles W. by N. from London, on the banks of a small river, which rises at Wycombe, and, in its course through this parish, turns several corn and paper mills. A weekly market on Fridays has been held from time immemorial, and is a great mart for corn and other articles; here is also an annual fair. This borough has lent members to parliament from the 28th year of Edward I.: the right of election is vested in the mayor, aldermen, bailiffs, and burgesses; and the number of voters is about 180. Edmund Waller, the poet, was one of the representatives in 1635; Sir Edmund Verney, king Charles's standard-bearer, who fell at the battle of Edgehill, was elected to the parliaments of 1639 and 1640; and Thomas Scott, the regicide, was a member during the protectorate of Cromwell. The first incorporation of the town appears to have been in 1461; but the mayor and aldermen are mentioned in a record of the reign of Edward III.: the earliest charter now extant bears date 1586. The corporation consists of a mayor, twelve aldermen, a recorder, and other officers; formerly here was a high steward, but the office was annulled by a charter of Charles I.; yet since that time it has been held (by virtue of former charters) by the earl of Bridgewater, lord-chancellor Jefferyes, and the marquis of Wharton. According to the population return of the year 1811, the town contained 494 houses and 2490 inhabitants: the parish is extensive, and includes several hamlets, which make an addition of 2266 to the population, and 449 to the number of houses. The manor of Wycombe having passed through a variety of families, was sold, together with the manors of Loakes and Windfors, or Chapel-fee, by Thomas Archdale, esq. in 1700 to Henry Petty, lord Shelburne, who bequeathed all his estates to his nephew, John Fitzmaurice, afterwards earl of Shelburne. His son, who in 1784 was created earl Wycombe and marquis of Landown, sold these manors by auction, which were purchased by the present proprietor, lord Carrington. The manor-house of Loakes, situated near the town, was considerably enlarged and improved by lord Shelburne, and the marquis of Landown bestowed much expense in laying out the gardens and pleasure-grounds. The house has been almost wholly rebuilt by the present noble owner, from the designs of James Wyatt: it is now called Wycombe-abbey. The parish-church of High Wycombe is mentioned by Worlow as having been built in the reign of Henry II.: the present fabric is of much later date, and the tower was built in 1522. Between the aisle and the chancel is an ancient oak screen, which, by an inscription, appears to have been put up in 1460, at the expense of the Redhead family. In the chancel is a monument to Henry Petty, earl of Shelburne, who died in 1751. It was executed by Scheemakers, at the expense of 2000L, which was bequeathed by his lordship for that purpose. In the south aisle is a very handsome monument by Carlini, for Sophia, countess of Shelburne, (first wife of the late marquis,) who died in 1791, with a female figure reclining on an urn. In the church are memorials of the families of Archdale, Llwyn, Shirrington, and Bradshaw. William Bradshaw, who died in 1614, was 103 years of age. In the church-yard is the tomb of Robert Williams, the late sexton, who died in 1793, at the age of 102. Two hospitals for lepers were founded in this town in the early part of the 15th century: one of them was granted by queen Elizabeth to the corporation; and the lands are now applied to the maintenance of an hospital or alms-house for poor people, and a grammar-school.

**WYCOMBE**, Wee, is a populous village and parish in the hundred of Desborough, situated about two miles N.W. by W. from High Wycombe, on the road to Oxford. It was anciently called Haverinden. The manor was from a remote period till the Reformation attached to the fee of Winchester; the present proprietor is Sir John Dalwood King, who has a seat here, named Wycombe-houte, which was built by sir Francis Dalwood, but was much enlarged,
enlarged, and furnished with a profusion of ornaments by his son lord Le Defencer. The parish-church stands on the summit of a steep hill, at a small distance from the village, within the site of an ancient circular intrenchment. It was rebuilt in 1763, (except the tower and chancel, which are parts of a more ancient structure,) by lord Le Defencer, who fitted it up in the Grecian style: the ceiling is painted with Mosaic ornaments. Near the east end of the church is an hexagonal building, erected by his lordship. One side of this building is inscribed to the memory of John, earl of Welfordmoreland, and another to George, baron of Melcombe Regis, whose issue to lord Le Defencer, for the purpose of erecting a monument to his memory, was the cause of his lordship's building this singular mausoleum. Within it are several recesses for monuments, and niches for arms and busts. The population of this parish, in the return of the year 1811, is rated to be 1562; the number of houses 273. — Lyons's Magna Britannia, vol. i. Buckinghamshire, 1806. Beauties of England and Wales, vol. i. Buckinghamshire, by J. Britton and E. W. Brayley, 1801.

WYDAW, a river of Denmark, which runs into the North sea, near Tondern, in the duchy of Sleswick.

WYDRAUGHT, a water-courte, or water-passage, to carry off the filth and filiuage of a house; properly a sink, or common-fewer.

WYE, in Geography, called by Leland, in his Itinerary, a "pratie market towns," is now only a considerable village of the county of Kent, England, as its market has been long discontinued. In the Domestick-book it is written Wi, and by that appellation it was granted by the Conqueror to the abbey of Battle, in Sussex, which he had founded in commemoration of his victory over Harold, it having been previously a part of the demesne lands of the Saxon kings. "The Chronicles of Battle abbey affirm," says Lambard, "that there were sometime two-and-twenty hundredths subject to the jurisdiction of this manor." The extensive grant of the royal manor of Wye, with all its appendages, liberties, and royal customs, was confirmed to the abbey of Battle by different sovereigns, and it continued parcel of its possessions till the period of the dissolution. Queen Elizabeth, in her first year, granted it, together with various esates in the vicinity, to her kinsman, Henry Cary, lord Homfdon, to hold in capite by knight's service. The church of this parish was made collegiate by archbishop Kemp, who was a native of the place, and is supposed to have rebuilt this edifice at the same time that he founded the adjoining college, in the year 1447. It consists of a nave, aisles, and chancel, with a large embattled tower at the south-east angle; the nave is separated from the aisles by four pointed arches on each side, rising from clustered columns; the chancel was rebuilt at the commencement of the last century, and has a semicircular east end.

The ancient college, now the grammar-school, founded by archbishop Kemp, stands on the east side of the churchyard. He endowed it for a provost and six fellows, "two of whom had an additional stipend for the duty of the church, and care of a grammar-school," in which all scholars, both rich and poor, were to be instructed gratis. Another school was instituted here about the year 1708, under a bequest of lady Joanna Thornhill, who, among other charities to the poor of Wye, directed that the residue of her estates should be applied to the instruction of their children. Sir George Wheeler added to this foundation, and gave the college as the residence for the master of the grammar-school, and for the master and mistresses of lady Thornhill's school. The college buildings form a quadrangle, and the old hall is a large vaulted room, now used for the school. The population of this parish in the year 1811 consisted of 1322 persons, who occupied 224 houses. In this parish is Ollantigh, where archbishop Kemp was born in 1580, and where towards the end of his life he built a chapel, or oratory. Here also it is conjectured was born Thomas Kemp, bishop of London, and nephew of the archbishop. John Sawbridge, a patriotic alderman of London, was likewise a native of this place, where he was born March 17, 1732, and where he died in 1795. His sister, Mrs. Macaulay Graham, an English historian, derived her birth from this place on the 23rd of March 1731. (See Graham, Macaulay.) About one mile N.E. from Ollantigh, a Roman burying-place was discovered in the year 1703, and several skeletons, urns, and other vestiges of interments, have been discovered, and are now preserved at Heppington, in this county.—Hafted's History, &c. of Kent, 12 vols. 8vo. Beauties of England, &c. Kent, by E. W. Brayley, 8vo. 1806.

WYE, a river of South Wales, is rendered particularly noted, in consequence of the high praires bestowed on it by topographers, tourists, and poets. The shores of this famed stream are distinguished by bold, rocky, and woody scenery, and adorned by several towns, seats, castles, and abbeys. The poet Gray says, "its banks are a succession of nameless beauties." Taking its source on the south side of the mountain called Phlinimon, in Montgomeryshire, within a quarter of a mile from the spring-head of the river Severn, the river takes a course in general to the S.E. between the counties of Brecknock on the W. and Radnor on the E. Entering Herefordshire, it winds by and partly through the capital of that county; and then turning southward, it forms the boundary between Gloucestershire on the E., and Monmouthshire on the W., until it unites its stream with that of the Severn, a few miles below Chepford. At its source, the scenery is wild, romantic, and bare; but after descending to Builth, the scenes are extremely beautiful. In the valley of Glafrbury, the stream is so considerable as to have required in 1783 a stone bridge of seven arches, which twelve years afterwards was swept away by the floods. At Hay, where it enters Herefordshire and receives the waters of the Dulais, the Wye is so much increased in the winter season as to be navigable for barges. From thence to Hereford it winds through a continuation of rich and beautiful scenes, and pdties by many pleasant villages and country-seats. Bradwardine, a village, where in ancient times stood a castle, on the right or south bank, gave name to Thomas Bradwardine, archbishop of Canterbury, who was flayed from the depth of his learning "the profound doctor." About three miles lower down is Moccas-court, the modern residence of Sir George Cornwall, bart. About six miles below Hereford the Wye receives the Lug, one of the three principal rivers of the county, flowing in general south-east from the borders of Radnorshire. "Near the confluence of the Lug and Wye," says Camden, "to the east, a hill called Marlacid-hill did, in the year 1575, robute itself as it were out of steep, and for three days together, flowing its prodiugious body forward, with a horrid roaring noise, failed itself, to the great affroment of all beholders, to a higher place." Two miles below the influx of the Lug, but on the west side of the Wye, is Holme-Lacy, the ancient seat of the Scudamores, the heiress of whom married the late duke of Norfolk. The manor occupies the site of an abbey, which was founded in the time of Henry III. Five or six miles lower down, and on the same side of the Wye, is Harewood, a remnant of the forest of that name, selected by
by Malon as the scene of his drama of Elfrieda; for there
Ethelwold, the confidante of king Edgar, had his castle, in
which the fair Elfrieda was concealed. Five miles farther
down, on the east bank of the river, is Rofs, confequently in
the poetry of Pope by his fascinating defcription of what
could be and actually was accomplished by the “Man of
Rofs,” with “five hundred punds a year.” The memory of
this worthy man, John Kyrie, is preferved by a monu-
ment in the church of Rofs. On the weft side of the river
are the remains of Wilton castle, a Norman structure, once
the residence of the Greys. Following the courfe of the
Wye on the weft, on the summit of a bold promontory
clothed with wood appear the lofty towers of Goodrich
castle, of great antiquity; for in 1294 it was granted by
king John to Marshall, earl of Pembroke. The views
from the castle are extensive and highly interesting. At
Coldwell rocks the scenery of the Wye is peculiarly grand,
the prominences are overhung with oaks and shrubs, and
separated by deep shadowy dells. From Symond’s-gate or
Yat, the summit of a lofty hill, the spectator discovers a
fingularly grand view of the windings of the river, and its
romantic banks. Soon afterwards, entering a short way into
Monmouthshire, the Wye bathes the walls of the capital,
near which is Troy-houfe, the ancient feat of the duke of Beauf-
fort, and affuming a southern direction, runs along the limit
between that county and Gloucefherife. The courfe of the
river, in the latter part of the range, is lefs irregular than that
through Herefhorfe, but it is not lefs interesting. About a
mile diftant from its eft bank, on an eminence, stands St.
Briavel’s eastle, once of great extent and great strength,
erec ted by Miles, earl of Hereford, in the reign of Henry I.
Lower down the fream and on the west bank is the curious
village of Llandogo, difperfed among trees on the fide of a
hill. Proceeding down the river by an easy bending courfe,
in the midft of very picturesque scenery, appear the dilapi-
dated and highly picturesque remains of Tifern abbey, at
the opening of a valley on the west bank. This venerable
ruin is apparently inclofed by steep hills and hanging woods,
which are separated by the broad fream in the bottom.
Passing much scenery equally beautiful, the east bank of the
river prefents a fcreen of rocks, called Thorn and Black
Cliffs, to which the tide reaches, and afterwards marthly
lands appear on both fides. Next appear the rocks belonging
to the celebrated grounds of Pi erfield. Thence refemble
the projecting battons of a castle, and powerfully rever-
berate founds that ftrike againft them. A little lower
down is the Lover’s Leap, a precipitous rock; and the
next sweep of the river brings before the eye the noble re-
main of the castle of Chepflow, perched on the summit of a
lofty perpendicular cliff, impending over the weft fide of
the river. The fitation of the castle and the town of
Chepflow is peculiarly picturesque. The beauties of the
fe scene are, in the opinion of Mr. Wyndham, “fo excellent,
that the moft exact critic in landscape would scarcely with
alter a position in the afsemblage of woods, cliffs, ruines,
and water.” Chepflow caflle is undoubtedly ancient, and
Roman-Britifh bricks are discovered in the walls; but its
foundation can be traced only to Fitzborne, earl of Here-
ford, who erected it for the defence of the possessions he
received from William of Normandy. Notwithstanding the
height and rapidity of the tides at Chepflow, a bridge has
long been established there acrof the Wye. It was formerly
constructed wholly of timber, but is now made of cafl-iron.
Although the tide be feinfuly perceived only about Tintern abbey, five miles above Chepflow, yet the
water rifes in the river at this town to a very extraordinary
height. Formerly not lefs than seventy feet, as it is afferted;
but fifty-fie head is the greatest rife observed during the laft
hundred years. The tide setting up the Britifh channel
from the Atlantic is, by the gradual contraction of its
courfe, forced to swell up in a very uncommon manner;
and its progres is still farther impeded by the advance of
the land on the north of the entrance of the Wye, up which
river, as well as more directly up the Severn, it rushes with
peculiar force. In defending the Wye from Chepflow, the
high impeding rocks have a very flriking effect. At the
confluent with the Severn, three miles below the town, the
courfe of the latter river appears, bounded by the diftant hills
of Gloucefherife and Somerfetshire. The general charac-
ter of the river Wye is thus refpecred by Mr. Coke: “It is
diftinnguifhed by its fervente courfe, the uniform breadth of
its channel, and the scenery of its banks. In the navigable part
from Hereford downwards, the banks for the most part rife
abruptly from the edge of the water, and are clothed with
foreifts and broken cliffs. In some places they approach fo
near that the river occupies the whole intermediate space,
and nothing is feen but wood, rock, and water: in others
they alternately recede, and the eye catches an occafional
glipfe of hamlets, ruins, and detached buildings, partly
feated on the margin of the fream, and partly feattered on
the rising grounds. The general charac ter of the feenery,
however, is wildness and solitude: and if we except the
populous district of Monmouth, no river perhaps flows for
fo long a courfe through a well-cultivated country, the
banks of which exhibit fo few habitations.” Large
hoys fitted to navigate the Severn can, with the tide, ascend
the Wye to Brookwear, a populous village midway between
Monmouth and Chepflow, where they receive from and tran-
fer into small craft the various commodities with which they are
loaded. The Wye as well as the Severn furnifhes a con-
liderable quantity of falmone.—Beauties of England and
Wales, North Wales, by the Rev. J. Evans, 8vo. 1810.
Ditto, Monmouthshire, by J. Britton, 1808. Hifto-
William Gilpin, 8vo. 1789.

WYE, a river of England, which runs into the Derwent,
near Bakewell.—Alfo, a river of Maryland, which runs into
the Cheapeak, N. lat. 38° 54′. W. long. 76° 20′.

WYENOKE, a town of Virginia.

WYERSDALE, INFEFER, a township in the hundred of
Amournderefs, county palfinte of Lancafefer, England,
is situated four miles N.N.E. from Garifand, and was ftated
in the return of the year 1811 to contain a population
of 713 perfons, occupying 145 houfes.

WYERSDALE, Over, a township in the hundred of Lon-
dale South of the Sands, Lancafefer, England, is situated
six miles N.N.E. from Garifand, and in the year 1811
contained 154 houfes and 802 inhabitants. A colony of
Ciferian monks were for some time fixed here, but about
A.D. 1188 they removed into Ireland, and founded the
abbey of Wytnuey.

WYERSDALE FOREST. See LANCASTHIRE, Forests in.

WYFFLERS, in Military Language, fubordinate officers
in the Englifh infantry, whole businefs, in the time of queen
Elizabeth, appears to have been to drill the men, to in-
ftruct them how to carry their arms, and to arrange them
according to their ranks in proper order.

WYFORDBY, or WYVERBY, in Geography, a small
parish in the hundred of Framland, county of Leicefer,
England, is situated three miles E. from Melton Mowbray;
and in the population report of 1811 was returned as con-

WYK

containing 20 houses, and 97 inhabitants. It includes the hamlet of Brenchley.

WYGBYGERA, a town of Sweden, in Angermannland; 30 miles N. of Hernfand.

WYGELN, a high mountain of Norway.

WYHAM, a parish in the wapentake of Ludborough, in Lindsey division of the county of Lincoln, England, is situated 7 miles N.N.W. from Louth; and was flated in the year 1811 to have a population of 87, occupying 10 houses.

WYHOMICA, or Wyhomie, a town of Lithuania; 20 miles N.E. of Pink.

WYK, a town of Sweden, in the province of Småland; 65 miles N.N.W. of Calmar.

WYKA, a town of Sweden, in Dalecarlia; 14 miles S.E. of Falun.

WYKE, anciently denoted a farm, hamlet, or little village.

WYKE, in Geography, a tything in the parish of Wropledon, hundred of Woking, county of Surrey, England, is situated 6 miles W. by N. from Guildford, and was returned in the year 1811 as containing 30 houses, and 125 inhabitants.

WYKE Regis, a parish in the hundred of the same name, in Dorchester division of the county of Dorset, England, is 2 miles W.S.W. from Weymouth. The population in the year 1811 was returned as 570, the number of houses as 134. The church, which is the mother-church to Melcombe Regis, is a spacious building, with a lofty tower, serving as a landmark. From this village there is a ferry to Portland Isle.

WYKE-Hamon, a parish in the hundred of Cleley, Northamptonshire, England. The church is in ruins. The population is included with that of the adjoining parish of Wykens, or Wyke Dyve.

WYKEHAM, in Biography. See William of Wykeham.

WYKEHAM, or Wycombe, in Geography, a township in the hundred of East Goscote, county of Leicester, England; 5 miles N.E. by N. from Melton Mowbray. The population, including the adjoining township of Caldwell, was in 1811 stated to be 95, occupying 25 houses.

WYKEHAM, a township in the east division of the wapentake of Pickering Lythe, North Riding of the county of York, England; 6 miles S.W. by W. from Scarborough; and in the year 1811 contained 87 houses, and 511 inhabitants. About the year 1153, Pain Fitz Obert built and endowed a priory for Cistercian monks at this place. At the dissolution there were nine religious persons in the house, with an estate of 25l. 17s. 6d. per annum. Henry VIII. granted the house to Francis Pook.

WYKEHAM, Esq., is a parson in the Wold division of Louth-Elke hundred, in Lindsey part of Lincolnshire, England, situated 7 miles N.W. by W. from Louth. The church is in ruins. The population was stated, in the return of the year 1811, to be 23, the number of houses 4.

WYKEHAM, Rev., is a parson in the east division of the wapentake of Wragge, in Lindsey division of Lincolnshire, England, adjoining to the foregoing. The church is also in ruins.

WYKEN, a parish in the county of the city of Coventry, Warwickshire, England, is 3 miles N.E. by E. from the city; and, according to the population return of the year 1811, contained 13 houses, and 72 inhabitants.

WYKENS, or Wyke-Dyve, a parish in the hundred of Cleley, county of Northampton, England, situated 7 miles S.E. by S. from Towcester, and 3 miles W.S.W. from Stony-Stratford; Bucks. This parish is united with that of Wyke-Hamon, and in 1811 the joint population was returned as 385, the number of houses as 57.

WYLAM, a township in the parish of Ovingham, Tyne-dale-ward, county of Northumberland. In the year 1811 it contained 159 houses, and 795 inhabitants; 9 miles W. from Newcastle.

WYLER, John, in Biography, the author, or rather the compiler of a tract on music in the MS. of Waltham Holy Cross, now in the possession of the marquis of Lansdown, entitled "Mufica Guidonis Monachi." It is the first in the volume, but not written by Guido, as the title seems to imply, but an explanation of his principles; it is divided into two books, and appears to have been compiled by the precentor of Waltham abbey, John Wylde, pr. "Quia juxta Sapientiflimum Salomonem dura efft." The author does not confine himself to the doctrines of Guido, but cites later writers. The basis of the tract, however, is the Micrologus, and his other writings, in which he treats of the monochord, the scale, the harmonic hand, the explanation of which he calls manual music, ecclesiastical tones, foliation, clefs, with a battle between B flat and B natural, are the subjects of the first book, consisting of twenty-two chapters.

The second book, or distillation, contains thirty-one chapters. In the first he speaks of a Guido Minor, famed Augenfis, as a writer on the ecclesiastical chant. He had mentioned this author in the seventh chapter of the first book; but who he was, or when he lived, we are unable to discover. It seems, however, as if some such musical writer had existed, and that his name, by the ignorance or inattention of the scribes of ancient MSS., had been confounded with that of Guido d'Arezzo.

In several of the succeeding chapters he treats of intervals and their species, offering nothing new or singular, except where he draws a parallel between the tone and feminine, and Leah and Rachel, Jacob's wives, which, it is presumed, will excite no great curiosity in our readers.

Attention is engaged, however, in the tenth chapter, by a "Cantilena," as the author calls it, of the Great Guido. It is a kind of folleggio, or exercise for the voice, through all the intervals, which is only rendered valuable, perhaps, by the supposition of its having been produced by the celebrated author of the musical alphabet. See Serra.

WYLIA, in Botany, another new umbelliferous genus of professor Hoffmann's, (see Wendia,) dedicated by its author to Dr. J. Wylde, privy councillor to the emperor of Russia, inspector of medicine and surgery in the Russian army, &c. &c., author of a Pharmacopoeia Cabrensis Ruthenia, in which his highly commendable aim has been to indicate the medical properties, and to fix the names of the native plants of Russia.—Hoffm. Gen. Plant. Umbellif. v. 1. 3. 1. 2.—Clas and order, Pentandria Digynia. Nat. Ord. Umbellatae, Linn. Umbelliferae, Jaff.

Gen. Ch. General Involution of one ovato-lanceolate, membranous, half-claeping leaf, fringed with hairs; partial of five ovate, nearly entire, concave, two or three-ribbed leaves, bordered with a pellucid fringed membrane. Petals of five minute teeth, permanent. Cor. universal regular; flowers of the disk perfect, fertile, as well as the female ones which form the radius; some male flowers are either interperforated in the disk, or disposed in separate umbels; partial of five petals; unequal in the flowers of the radius, the outermost very large, either obovate and flattened,
tened, or inversely heart-shaped, with a long claw; equal in those of the dish. Steam. Filaments five, thread-shaped, at first inflexed, and concealed in the hollows of the petals, afterwards prominent; anthers roundish. Pifi. German ovate-oblong, more or less tapering; styles erect, thread-shaped, nearly equal, flanging on a cup-shaped base; stigmas simple. Peric. Fruit linear-oblong, beaked, somewhat compressed, crowned with the erect, permanent, and their cup-like, slightly notched basis. Seeds two, linear-oblong, hispid, frigated, the ribs elevated, continued into the beak with intermediate furrows; valves of the beak parallel to the fruit.


Obf. The chief differences which have led professor Hoffmann to separate this genus from Scandix, (see that article,) appear to be the nearly entire leaves of the partial involucrum, which are laminated in Scandix; the radiant corollas, and, as he says, the valves of the beak being parallel, not contrary to the fruit; that is, as we presume, compressed in a contrary direction in one genus to what they are in the other. For this we rely on the learned and judicious author not having materials sufficient to verify his observation. We must remark, that the involucral leaves in Wylias, though not laminated, have a noteb or two at the end, and precisely accord in texture with those of Scandix. Many of the umbels in this genus are simple, or occasionally two or three together, resembing a compound umbel.

1. W. affratis. Southern Wylia. Hoffm. n. 1. t. 2. f. 1. (Scandix affratis; Linn. Sp. Pl. 369. Sm. Fl. Grec. Sibth. t. 285, unpubl. See Scandix n. 6.)—Um-bels simple, or in pairs, of few flowers. Radiant petals obovate, nearly entire. Beak of the fruit almost straight.—Native of fields in Italy and the Levant, as well as in Tauria, about Sudak, flowering in May. Root annual. Herb slender. Stem round, sometimes quite smooth, sometimes more or less hairy. Leaves triplicate pinnate, with linear acute segments, and hairy, or rather fringed footstalks. Umbels small and dense, on long stalks; the lower ones opposite to the leaves, solitary and fimple; upper in pairs, rarely three together, and even in that case not constituting a real compound umbel, as an examination of specimens will readily shew. Flowers white, moderately radiant. Largest petals sometimes slightly emarginate. Fruits from six to ten perfected in each umbel, their beaks nearly or quite straight, quadrangular, rough with short erect bristles.

2. W. radian. Radiating Wylia. Hoffm. n. 2. t. 2. f. 2. (Scandix radian; Mar. Taur.-Cacafv. v. 1. 424. S. falcata; Ld. Journ. de la Soc. des Naturalist. de Mofcou, for 1805, 57. t. 5.)—Um-bels aggregate, from two to five, many-flowered. Radiant petals elongated, wavy. Beak of the fruit incurved.—Frequent in Tauria, flowering in May. This is confidered by the authors who have described it as about equally related to the foregoing and to the grandiflora. We have no other guide than a beautiful engraving, copied by Hoffmann from the figure above cited, with the addition of the magnified and diffused fructification. By this it appears that the partial umbels are rather more numerous assembled, making more apparently compound umbels. The flowers are more copiously radiant. Fruits more numerous in each umbel, from twelve to twenty, with strongly incurved rough beaks. We confess ourselves unable to determine these two species clearly by the specific differences of professor Hoffmann, which we subjoin for the satisfaction of our readers.

W. affratis, caule petiolo umbellifere hirsutus, corollas petalique radianlibus obovatis integris.

W. radian, caule petiolo pilosis, umbellis glabris, corollis petalis fruticulique radianlibus.

The hairiness is evidently variable, and the other characters, perhaps from some typographical error, do not contrast with each other.

3. W. grandiflora. Large-flowered Wylia. Hoffm. n. 3. t. 2. f. 3. (Scandix grandiflora; Linn. Sp. Pl. 369; i.e Scandix n. 10. Marich. Taur.-Cacaf. v. 1. 250.)—General umbels of from three to five very hairy rays. Radiant petals slightly emarginate.—Native of fields in Tartary and Georgia, flowering in May and June. Having discovered a specimen of this in our collection since the article Scandix was written, we are enabled to compare it with the descriptions of authors, and to select the following particulars:—The root is annual, tapering. Stem about a foot high, round, purplish, slightly branched, quite smooth in our specimen; Hoffmann says clothed with long hairs. Leaves much like the last; their footstalks somewhat hairy. Umbels terminal; the general ones sometimes on short stalks, each composed of from three to five long, slender, coarsely and abundantly hairy rays, with a leafy, simple or divided, linear leaf, in the place of a general involucrum. Partial umbels of numerous short smooth rays; their involucrum of several, mostly double-pointed, ovate, white-edged, fringed leaves. Flowers remarkably radiant; their largest petals obovate, not always emarginate, each furnished with a long claw. Beak of the fruit rather fealy, as Hoffmann delineates it, than hairy. His figures, in this and the other species, except radian, exhibit the parts of fructification only.

4. W. iberica. Georgian Wylia. Hoffm. n. 4. t. 2. 4. (Scandix iberica; Mar. Taur.-Cacaf. v. 1. 425. S. faculta; ibid. 230, excluding the synonym.)—General umbels of from four or five very smooth rays. Radiant petals emarginate, with an inflexed point. Stem somewhat hairy at one side.—Native of Georgia. Annual. Very nearly related to the last in habit and size. The stem is, as in that, sometimes quite smooth. The rays of both general and partial umbels are said to be always very smooth. Radiant petals of a smaller proportion, and, as it seems to us, essentially distinguished by their sharp inflexed points. The beak of the fruit is described as marked with two hairy lines, and not hairy in every direction. We have seen no specimen.

WYLER, in Geography. See WILSTER.

WYMERING, a parish in the hundred of Portsdon, Hampshire, England, returned in the year 1811 as containing 121 houses, and 740 inhabitants; 4 miles W. from Havant.

WYMINGTON, or WINNINGTON, a parish in the hundred of Wylye, county of Bedford, England, is situated 12 miles N.W. by N. from the county town, and about 3 miles from Higham Ferrers, Northamptonshire. Wymington church, a fine structure, was built by John Curteys, then lord of the manor, and mayor of the flate at Calais, who died in 1391, as appears from an inscription on his tomb. The bafes of himself and his wife are on a flab of black marble under canopies, and are well preserved. The population of the parish, in the return of 1811, was stated to be 235, the number of houes 40.

WYMOA BAY, a bay on the S. coast of Atooi, one of the Sandwich islands. N. lat. 21° 57'. E. long. 200° 20'.

WYMONDHAM, or WINDHAM, a market-town in the hundred
It is very ancient, and was formerly surrounded with walls: the inhabitants still possess an exemption originally granted to the duchy of Lancaster. In the return of the year 1811, the population was stated to be 437, occupying 81 houses.

**WYMONDLEY, or Wymondeley, Great, a parish in the hundred of Brinkwater, county of Hertford, England, situated within three miles E.S.E. from Hitchin. The manor was given by William the Conqueror to a noble Norman, named Fitz-beck, by the service of grand ferjeantry; that the lords of the said manor should present to the kings of England the first cup of drink at dinner on the day of their coronation: the cup becoming the property of the said lords. This service has continued with the manor: lieutenant-colonel Cracherood performed the office of cup-bearer at the coronation of George III. The population of the parish was, in the return of 1811, stated to be 212, and the number of houses 46.—Beauties of England and Wales, vol. vii. Hertfordshire, by E. W. Brayley.

Wymondley-houfe, in this vicinity, formerly the residence of a private gentleman, is now an academy for the education of Protestant Difsenting ministers. This institution originated at Northampton in 1729, by the endowment of William Coward, esq. a West India merchant. The celebrated Dr. Doddridge was the first tutor, which office he held twenty-two years. In 1752 the academy was removed to Daventry, and thence back to Northampton; and finally in 1799 to this place, having been previously united with an academy in London, under the successive tuition of Mr. Eames, F.R.S., Dr. Jennings, Dr. Savage, Dr. Kippis, and Dr. Rees, supported by the same fund, and unfortunately for the interests of literature and science discontinued. The library contains a valuable assemblage of upwards of 10,000 volumes of the best authors in divinity, criticism, classics, mathematics, topographical antiquities, &c. with a cabinet of medals, a collection of natural history, and other curiosities. This valuable library consists principally of a rich collection of books, bequeathed by the late Rev. Mr. Miles, F.R.S., and appropriated to the London Academy, and augmented by numerous purchases.—Beauties of England and Wales, vol. vii. by E. W. Brayley. And Private Information.

**WYNANTS, John, in Biography, an able and eminent landscape-painter, born at Haarlem in 1660. Whether he was his own instructor or not does not appear, or how he qualified himself to attain that station among the artists of his country which he so justly holds. His pictures are taken from the dimple scenes of nature which surrounded his birth-place, and which he has represented with great vivacity and reality, though they sometimes are overcharged in their contrails of colouring. A fandy bank, with broken patches of grass and plants, with fluntered trees befoe it, and a winding road paffing over the bank, prefers from his pencil an agreeable and interesting effect. Sometimes we find the entrance of a wood, with a cottage or hovel before.
beside it, treated by him with great attention to the varied
effect of colour in nature, and a dexterous management of
chiaro-oscuro; and always with the most free and skillful
touch, though generally upon a small scale. As he painted
with facility, his works are not rare, though they bear a
good price when in perfect preservation. Wynants estab-
lished an academy, which produced many excellent
painters. Among others of great celebrity, were Adrian
Vandevelde and Philip Wouvermans, both of whom occa-
sonally embellished their master's pictures with figures.
He died in 1670, aged 70. He left numerous beautiful
etchings of landscapes.

WYNNE, Mrs. CASSANDRA FREDERICA, the finest
harpsichord player of her time. She was the daughter of
Signora Pompeo, the second female finger in Gluck's opera
of "La Caduta di Giganti," performed in 1746, on
the suppression of the rebellion; but though she nominally per-
formed the part of second woman, she and fun in so
maafuhlne and violent a manner, that no female symptoms
were discoverable. But this lady was better known after-
wards by the name of Madame Cornelly, whose concerts,
ridottas, assemblies, and masquerades, in Soho-square, were
the gaitest and most fashionable amusements in London
during many years.

The little Frederica, daughter of the Pompeo, was an
élève of Paradis's, (some say his daughter, and the first
early player, the neatest, and the best which had ever ap-
ppeared in our country during infancy, performing at five
years old, with the utmost precision and firmness, propped
up by cushions, the whole book of her master's twelve ex-
cellent lessons, probably composed expressly as progresive
exercises for her use, with many lessons by Scarlatti and
Alberti.

In 1769, when grown up, she went into Italy, where she
was the wonder and subject of eloq in that mother and fest
of arts. We have often heard her perform at different
periods of her life, and continued to think her improved to
the last.

WYNNE, ———, efq., a Yorkshire gentleman, one of the
best dilettanti performers on the violin that we have heard.
He was a man of fortune, and of an ancient family. To gratify
his passion for music, he went into Italy early in life, where
he married, and remained in different great cities till he had
almost totally forgotten his mother-tongue. He likewise
travelled through Germany, and having two daughters, he
had always a music-matter on his establishment, not only to
instruct them, but to accompany himself. When he was
laid in England, he had Pfeifer with him for these purposes,
and with a German, and an excellent musician and performer
on several instruments, who died in London of a consump-
tion.

Besides being a good performer on the violin, Mr. Wynne
had studied composition sufficiently to compose trios, which
were far above the common run of trios at that time in
point of taste and invention, and well put together.

WYNSBACH, in Geography, a town of Austria; 4
miles E. of Schwannlafta.

WYNSTER. See Winster.

WYOMING, a settlement and fort on the river Su-
quehanna. In the year 1778, this fort was attacked by a
party of Britifh and Indians. The garrison were soon
overpowered, and fell a prey to Indian barbarity; after a
bloody military execution of a great part, the reel were flut-
up in the barrack, to which they set fire, and consumed the
whole; 2 miles above Wilkesbarre.
WYTHE was for the least heinous ones. It was not fixed to any certain sum; but left at liberty, to be varied according to the case.

Hence also wythe, or wiitree, one of the terms of privilege granted our sportsmen; signifying a freedom or immunity from fines or americtaents: or, as it is vulgarly conceived, from being liable to be begged for fools, for lack of wit.

WYTHE, in Law, the same as wait.

WYTHE, in Geography, a county of Virginia, between the river Kanhawa and North Carolina, with 8356 inhabitants, including 1157 slaves.

WYTHERS. See WITHERS.

WYTOOTACKEE, in Geography, an island in the South Pacific ocean, about 10 miles in circumference; discovered by captain Bligh in 1789. S. lat. 18° 52'. E. long. 200° 19'.

WZETIN. See USETIN.

END OF VOL. XXXVIII.
I guide you in studying
of your lessons, and bring you to
areas of the Land.

RIST.

E.

er hath left me to
that she help me.
1; and Mary hath
shall not be taken

in heart ---
needful.

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thing needful" was

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the Lord Jesus,
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did Jesus make?
ul?" Why is it

ou sitting at the
os to his words?
g needful—the

ne above;

e.

his boundless love

ach stanza:
ose the “one thing needful!”

Let us choose the better part;

Let us give unto our Saviour

Each a loving, faithful heart.